NUMERACY IN INCLUSIVE EARLY CHILDHOOD CLASSROOMS: EMBEDDING LEARNING OPPORTUNITIES AND USING EFFECTIVE INSTRUCTIONAL STRATEGIES

by

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ABSTRACT

This literature review will address issues to consider related to teaching numeracy and mathematics to children with disabilities in inclusive early childhood classrooms. As inclusive settings and instruction in numeracy/mathematics at an early age become more common, it is important to closely examine teaching strategies and make appropriate adaptations for young children with special needs. The purpose of this paper is to examine (a) strategies for embedding opportunities for numeracy/math development across various learning centers in a preschool classroom, and (b) instructional strategies that may be effective when teaching math and/or numeracy skills to children with special needs in inclusive early childhood settings.

This dissertation is dedicated to my amazing husband and son, Damian and Fletcher Davenport. Thank you for supporting me in all of my endeavors, as well as for your continued love and encouragement. Without both of you, this dissertation would have never been accomplished. I love you so much.

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CHAPTER 1

LITERATURE REVIEW

Interest in the area of mathematics and numeracy at the early childhood level has increased in the last few years (Lee & Ginsburg, 2009). However, research is only in the beginning stages. Until recently, there has been a major emphasis on reading and literacy, but not on math and science (Epstein, 2003). Although the terms numeracy and math are very closely linked, and are often used interchangeably, they are not synonymous. Mathematics, specifically at the preschool level, includes the key components of number concepts, patterns and relationships, geometry, measurement, data collection, organization, and representation (Colker, Dodge, & Heroman, 2002). Numeracy, on the other hand, involves using mathematics in a more practical manner throughout our lives, including in our home, work, and community (Peters & Young-Loveridge, 2005). In 1999, Klein, Starkey and Wakeley noted that many young children in the United States are not receiving a broad and solid foundation for mathematical development at the preschool level. In a study conducted by Graham, Nash, and Paul (1997) focusing on young children's exposure to mathematics in childcare settings, it was found that although childcare teachers said that they believe mathematics is very important in early childhood, very little mathematics was presented to children in their classrooms, directly or indirectly. This may be due, in part, to a lack of understanding regarding the skills that should be addressed in preschool classrooms. Lee and Ginsburg (2009), through in-depth interviews with early childhood teachers, working with teachers in the classroom, personal experiences in teaching early childhood students, conducting early childhood teacher workshops, and informal conversations with early childhood teachers were able to identify nine misconceptions that early childhood teachers have about teaching mathematics to preschool children. These misconceptions include the belief that (a) children are not ready for learning about mathematics, (b) mathematics is only for the smartest children, (c) introducing simple numbers and shapes is enough, (d) language and literacy are more important than mathematics, (e) teachers need to provide an enriched physical environment and simply let children play, (f) mathematics in preschool should not be taught as a subject matter, (g) assessment in mathematics is inappropriate for preschool children, (h) children only learn mathematics through the use of concrete objects, and (i) computers are inappropriate for teaching mathematics to young children (Lee & Ginsburg, 2009).

Although different curricula and/or organizations identify and describe early math skills using different terminology, the concepts proposed are very similar. Table 1 compares the mathematical guidelines for two national organizations. Specifically, this figure highlights the similarities and differences between the National Association for the Education of Young Children (NAEYC) mathematic curriculum and The National Council of Teachers of Mathematics (NCTM) mathematics standards. As noted in Table 1, NCTM has developed specific standards for school mathematics (The National Council of Teachers of Mathematics, 2005). These standards include a description of the mathematical skills that children should know, understand, and acquire between the preschool years and grade 12. With growing knowledge that the early years are valuable to future learning of mathematics, NCTM included the prekindergarten year in its standards for school mathematics in the year

Table 1. Comparison of national mathematical guidelines / standards

NCTM STANDARDS	NAEYC LEARNING PATHS	EXAMPLES
Number and Operation	Number and Operations	Counts 1-4 items and starts to recognize the concept of "how many" (National Association for the Education of Young Children, 2005).
Geometry	Geometry and Spatial	Identifies characteristics of concrete 2-D and 3-D shapes (Downing et al., 2005).
Measurement	Measurement	Recognizes and labels measurable features of objects (heavy, short) (National Association for the Education of Young Children, 2005).
Algebra	Patterns/Algebra	Sorts objects into groups (Downing et al., 2005).
Data Analysis and Probability	Displaying and Analyzing Data	Starts to make simple graphs (National Association for the Education of Young Children, 2005).
Problem Solving	No similar content area	Problem solving by using new mathematical knowledge (National Council for Teacher of Mathematics, 2006).
Reasoning and Proof	No similar content area	Begin to make and investigate mathematic guesses (National Council for Teacher of Mathematics, 2006).
Communication	No similar content area	The use of mathematical knowledge to express ideas (National Council for Teacher of Mathematics, 2006).
Connections	No similar content area	The ability to apply mathematics to outside contexts (National Council for Teacher of Mathematics, 2006).
Representation	No similar content area	Creating representations to organize, and communicate mathematical ideas (National Council for Teacher of Mathematics, 2006).

2000 (National Association for the Education of Young Children, 2005). The ten NCTM standards include number and operations, algebra, geometry, measurement, data analysis and probability, problem solving, reasoning and proof, communication, connections, and representation. NCTM has provided these standards, not for individual topics of study, but rather to be intertwined in a way that supports mathematical learning and ideas (National Council for Teacher of Mathematics, 2005). NCTM believes that the foundation for children's learning in the area of mathematics is established in the very early years, and is learned both formally and informally.

Table 1 also illustrates that The National Association for the Education of Young Children (NAEYC) has divided mathematical learning into five content areas. NAEYC refers to these content areas as learning paths to highlight that children learn mathematical skills at various rates between the ages of 3-6 years. These learning paths include number and operation, geometry and spatial, measurement, patterns/algebra, and displaying and analyzing data (National Association for the Education of Young Children, 2005).

In summary, both NCTM and NAEYC identify and describe early math skills using slightly different terminology and categories. However, both entities are in agreement that the foundation for mathematical skill development begins in the earliest years and before formal education begins. New (1998) stated, "The period of early childhood is a time in which children's development is especially ripe for the enhancement of numerous social, emotional and cognitive capacities" (p. 3). Both the National Council of Teachers of Mathematics (NCTM) and the National Association for the Education of Young Children (NAEYC) recognize that establishing a strong foundation in mathematics for 3 to 6 year olds is crucial to later mathematics learning (National Association for the Education of Young

Children, 2005). In the following sections, strategies for embedding opportunities for numeracy/math development across various learning centers in preschool classrooms will be presented, and instructional strategies that may be effective when teaching math and/or numeracy skills to children with special needs in inclusive early childhood settings will be discussed.

Embedding Opportunities for Numeracy/Math Development in a Preschool Classroom

Bricker, Frontczak, and McComas (1998) define embedded instruction as a "procedure in which opportunities to practice individual goals and objectives are included within an activity or event in a manner that expands, modifies, or adapts the activity/event while remaining meaningful and interesting to children" (p. 73). This is important to keep in mind when designing preschool classrooms. When a preschool classroom is designed, it is also essential that the classroom is set up in a developmentally appropriate way so that it contributes to the children's development (Bredekamp & Copple, 1997).

Considerations regarding embedded instruction and developmentally appropriate practice need to be made as each activity area in the classroom is established. Activity areas are specific spaces within a classroom designed to provide activities that benefit all children and foster a variety of learning experiences (Bailey & Wolery, 1992). Activity areas within a preschool classroom may include a block area, housekeeping/dramatic play area, sand/water play area, arts and craft area, reading/language area, and outdoor play area. Mathematics and numeracy opportunities can be embedded into each of these activity areas. The following sections will discuss how numeracy and mathematics opportunities can be embedded into specific activity areas in a developmentally appropriate way. In addition, a review of the empirical research related to numeracy/math development in specific activity areas will be provided.

Block Area

The block area plays a major role in creating a mathematically rich environment in early childhood settings (Smith, 1999). Block areas can provide opportunities for children to learn mathematical concepts including, but not limited to, height, weight, length, and size (Bailey & Wolery, 1992). “Blocks are essential tools for creativity, dramatic play and geometry” (Smith, 1999, p. 3). As children explore and build in the block area, teachers can embed opportunities for mathematical learning. For example, when a child is excited after building a very tall tower, a teacher can expand on how tall the tower is by counting the number of blocks it took to build it, or how many hands high the tower is. The difference when using the children's hands and the teacher’s hands may also be discussed. In addition to teaching counting and numbers, classification skills can also be addressed. Blocks can be grouped into categories such as big/ small, squares/circles, short/long, etc. Spatial relationships such as on, in, between, under, in front of, and next to, can also be addressed in the block area. The block area can be expanded upon by adding large cardboard boxes in order to demonstrate spatial relationship concepts and to further facilitate mathematical learning in children, particularly for children with special needs (Egan, Lerner, & Lowenthal, 2003). For example, an early childhood teacher can help young children build a bridge out of cardboard boxes. The teacher can then help the children to position themselves next to, under, behind, and in front of the bridge, talking about each spatial relationship. In summary, in order for children to gain various educational concepts from block play, it is important for teachers/interventionists to encourage children’s block play and thinking to be more diverse and creative rather than repetitive and limited (Goetz & Baer, 1973). In fact, playing with blocks can help young children gain a concrete understanding of various concepts that are important for logical thinking in their daily lives as well as future academic and mathematical learning (Work, 2002).

Goetz and Baer (1973) investigated the idea that children's block building would be more creative/diverse as a result of positive adult reinforcement that focused on a particular characteristic of the block building (e.g., same or new constructions). This study took place in a university preschool classroom, in the block-building center, with three typically developing 4-year-old girls. Based on informal remarks from the classroom staff, all of the girls were identified as having deficits in the area of block building (e.g., no construction of blocks or repetition of the same structure). The researchers referred to the participant's block forms/constructions as block building behaviors. The word *form* specifically referred to how the participant used two or more blocks to create a specified shape/function. Twenty forms were arbitrarily defined (e.g., fence, ramp, arch, post, circle, simulation, etc.). In addition, the researchers identified two scores for the block building activities. The first score was called a form diversity score and was defined as the number of any of the 20 forms appearing at least once in any session. The second score was called a new forms score and was defined as the number of any of the 20 forms appearing in a session that had *not* appeared in any prior study session of block building. The new forms score was not used for any of the participants during their first session of the study. All of the children's constructions throughout the study were recorded photographically with a Polaroid camera. During the intervention phase of the study, the interventionist delivered two types of social reinforcement. The first type of reinforcement was reinforcement of different forms during which the interventionist used descriptive remarks to reinforce every first appearance of any form during the current session, but no forms that appeared during any previous sessions. This reinforcement continued for four to five sessions. The second type of reinforcement included the teacher delivering descriptive praise for every second usage and beyond of a form within the session. Throughout the study, two of the participants were free to use any number of blocks and the third participant was told that she had to use all of her blocks (e.g., 53 total blocks) during each session (Goetz & Baer, 1973). The results of this study showed an increase in form diversity with all three participants when they received reinforcement for creating different forms, and decreasing form diversity during reinforcement of similar forms. It was also determined that the number of blocks used during a session did not affect the number of constructions built. In summary, this study suggests that positive descriptive reinforcement of new block building forms can in fact contribute to academic mathematical growth in the area of geometry (Goetz & Baer, 1973).

Wolfgang, Stannard, and Jones (2001) explored the influence of block play on later mathematical performance. Specifically, the researchers conducted a longitudinal study in order to examine whether preschool aged children who performed high levels of block building showed high levels of mathematical achievement in later formal school settings. In this study, 37 preschool age participants from a play-based preschool in the southeastern United States were selected and the Lunzer Five-Point Play Scale (Hulme & Lunzer, 1966) was used to assess each participant's level of block play. The Lunzer Five-Point Play Scale ranks the child on their ability to adapt to using presented materials, as well as their intricacy of play. IQ, gender, and social economic status (SES) were controlled for by the researchers. Standardized tests and mathematics report card grades were used to measure outcomes for the 3rd, 5th, and 7th grade levels. The number of courses, number of honors courses, advanced math courses taken, and grades were used to measure high school achievement. The results of this study revealed that there was no significant correlation between the level of block play in preschool and the students' mathematical achievement on standardized tests and letter grades at the 3rd and 5th grade levels. However, the investigators found that in the 7th grade, there was a significant correlation between level of early block play in preschool and standardized math scores. In addition, participants showed a positive correlation between level of block play and all of the later middle school and high school outcome variables including the number of classes taken, average mathematics grades, and a combined weighted value of all mathematics courses taken. The researchers speculated that one possible reason for this positive correlation may be that, although preschoolers who demonstrate a high level of block play are in fact developing cognitive structures for higher performance in later mathematics, there is no standardized mathematics testing to confirm this theory any earlier than 7th grade. This finding may indicate that academic measures cannot be used to demonstrate the lasting effects of preschool block play until the beginning of the middle school years. In summary, this longitudinal study, while controlling for IQ, SES, and gender, suggests that beginning at the middle school level, there is a positive correlation between preschool block performance and later math achievement (Wolfgang, Stannard, & Jones, 2001).

Housekeeping and Dramatic Play Area

In the housekeeping and dramatic play area, children can learn mathematics and numeracy skills such as problem solving, number concepts, and measurement. The difference between the terms numeracy and mathematics is particularly evident in the dramatic play area. Not only are children learning about mathematical concepts, but they are able to apply them in their real life role-play. Number and measurement concepts can be taught by having props available such as play money, measuring tools, calculators, scales, height charts, sand timers, and cash registers (Colker et al., 2002). Teachers can participate in the children's play and ask them number questions such as, "How many pieces of cake do you need so that everybody has one piece?" (Colker et al., 2002). Other examples of embedding math and numeracy into the housekeeping area include incorporating measurement by setting up a shoe store and encouraging children to measure each others feet; practicing number concepts by counting out loud to find enough plates and cups for everybody; using simple algebra by sorting fruit, vegetables, and dairy items; and integrating problem solving skills by figuring out how to serve four children a cookie when only two big cookies are available.

Ghiaci and Richardson (1980) examined the effects of dramatic play on cognition. Twelve children, ranging in age from 3 to 5 years, participated in the investigation. Participants were randomly assigned to an experimental group or a control group. The experimental group participated in six, 1-hour treatment sessions that involved dramatic play. Each treatment session included five stages. In the first stage, children individually acted out an event within the group setting. The second stage involved dividing the children into pairs and carrying out a cooperative activity. In the third stage, children divided themselves into groups of three and performed acts of helping each other using pretend props. The fourth stage required children to divide themselves into two groups and then take turns acting out a short piece of drama. The fifth, and final, stage focused on relaxation and again had each child individually act out an event in the group setting. The control group did not participate in any of the treatment sessions, but did continue to interact with all of the children in the experimental group. Changes in cognitive structure were evaluated by using repertory grids before treatment, immediately after treatment, and one month after treatment. The repertory grid technique, developed in 1955 by George Kelly, is the methodological component of Personal Construct Theory (Beail, 1985). The grid allows the researcher to gain personal constructs (e.g., personal way of viewing/interpreting the world around them) from the participants, and then consider the relationships between the discriminations within a specific area (Beail, 1985). The grids were obtained by asking each child to categorize photographs of each of the six children in the group, including themselves, and describe the reasons for the categorization. The categorization procedure consisted of sorting the photographs into two piles and then describing the rationale for each. This process continued until the child was unable to indentify any new differences. Findings revealed a significant improvement in the number of concepts obtained from the experimental group. The experimental group demonstrated a mean increase of 2.2 constructs while the control group exhibited a mean decrease of .4 constructs. In addition, participants in the experimental group retained the constructs over a period of one month. In summary, the results of this research study indicated that dramatic play might be a valuable component of cognitive growth in typically developing children ages 3 to 5 years (Ghiaci & Richardson, 1980). Although the study by Ghiaci and Richardson (1980) did not relate specifically to the development of math and numeracy skills, this study does demonstrate that dramatic play provides young children with opportunities to develop cognitive skills which may support their math and numeracy development.

Sand and Water Play Areas

In addition to providing children with sensory experiences, the sand and water play areas provide children with opportunities to experiment with shape, weight, and quantity (Bailey & Wolery, 1992). In this activity area, the teacher may use sand, water, or a variety of alternative materials including dried beans, macaroni noodles, potting soil, or leaves. All of these materials can be utilized in conjunction with additional materials to promote mathematics learning. For example, measuring cups, spoons, and containers of various sizes can be provided for the children to use to support mathematical skills in the area of measurement. Furthermore, estimation and measurement concepts can be facilitated by the teacher as children determine which cup has more/less, which cup is empty/full, or how many cups it will take to fill a particular container (Colker et al., 2002). Jensen and Bullard (2002) discussed that filling a sand/water table with mud can provide numerous opportunities for children to practice math and science skills, including “making before-and-after comparisons; investigating solids, solvents, and solutions; examining components of various soils; exploring changes due to freezing and melting; measuring; investigating volume; practicing one-to-one correspondence; investigating questions; solving problems; and testing hypotheses” (Jensen & Bullard, 2002, p. 18).

There is no empirical research relating specifically to sensory play and mathematics development. However, Piaget used water play activities to study the developmental stage of self-contradiction, which includes the math/numeracy skills of classification and the elimination of contradictions. Using a bucket of water, Piaget explored children’s early cognitive concepts of floating and sinking, which he referred to as the child’s conception of physical causality, by giving the participants (ranging in age from 4 to 14 years) different objects and asking them to identify whether they would float on or sink in water. Then, the children were allowed to experiment with the objects in buckets of water. Based on these experiences, Piaget noted that children move through a series of contradictions in order to figure out when an object will float or sink. For example, children initially formulate an opinion based on weight alone. However, over time, they formulate opinions based on volume and air, as well as weight. Piaget asserted that early discoveries regarding floating and sinking later form into more advanced mathematical concepts related to volume, weight, density, and specific gravity (Piaget & Inhelder, 1958).

In summary, the sensory center can provide children with opportunities to explore, learn, and experiment with natural elements that teach them about the world (Isbell, 1995). Furthermore, this center can provide meaningful opportunities for children in the area of math and numeracy.

Arts and Crafts Area

The arts and crafts area is a place in the preschool classroom where children can express themselves creatively as well as strengthen their fine and perceptual motor skills. It is also an area where opportunities for math and numeracy learning can be embedded. For example, children can be encouraged to experiment with shapes and spatial relationships that encompass the content area of geometry. Teachers can support this learning by providing empty containers of various shapes and sizes for children to use to create sculptures (Colker et al., 2002). Furthermore, as teachers are working with children in the arts and crafts area, terms of comparison such as longer or shorter, and skinny or fat can be used to encourage thoughts about measurement (Colker et al., 2002). Children can also use number concepts by counting out items and identifying “how many” of a material they may need to use.

The impact of embedding math/numeracy learning into arts and crafts activities was explored by Silver (1973) who examined whether a group of thirty-four children with language and hearing impairments could develop concepts of space, order, and class in the context of art activities. The children, ranging in age from 7 to 15 years, were randomly selected from two schools for language and hearing impaired children. An additional 34 children, also with language and hearing impairments, served as the controls and did not attend the art classes. The children in the experimental group attended one forty-minute art class one time per week for 9 to 11 weeks. Drawing and painting activities were used to help children develop specific mathematical and logical ideas of space, order, and class. Specific skills that were taught included the ability to represent objects or events by description, going beyond description to elaborate on an experience, and using personal experiences or imagination. The Torrance Test of Creative Thinking (TTCT) (Torrance, 1974) and evaluations by a registered art therapist and university professor of art were used to measure outcomes of the art classes. The same tests were administered concurrently to 68 children with no impairments in a suburban public school. The skill areas that were assessed included the ability to; (1) conserve (e.g., the ability to recognize that an object remains the same despite an alteration in its appearance), group, order sequentially (e.g., show how a water filled glass would look as the glass is gradually emptied), and predict spatial relationships (e.g., relate objects in relation to other objects), (2) select images based on attributes and ideas, combine language with images, and represent attitudes, thoughts, and feelings, and (3) perceive and represent left-right, front-back, and above-below spatial relationships. Results revealed that there was significant improvement in the experimental group in all areas while the control groups did not show improvement in any of the areas (Silver, 1973). In 1977, Silver and Lavin conducted a related study asking the question of whether the same strategies used by Silver (1973) would be effective with children who have learning disabilities. Results indicated that the children improved significantly in their ability to form groups, order sequentially, and orient spatially (Silver & Lavin, 1977). These studies support the idea that instruction in mathematical skills such as the ability to associate and to represent concepts, order sequentially, predict, and represent spatial relationships can be successfully embedded into art activities.

Reading and Language Area

The reading and language area is another early childhood center where math and numeracy opportunities can be embedded. Literacy opportunities in the earliest years, such as retelling or creating stories can lead to increased mathematical success during the elementary years (Clements & Sarama, 2006a). Furthermore, many books have clear mathematical connections. For example, in the book *The Very Hungry Caterpillar* by Eric Carle, a teacher can ask the children how many different foods the caterpillar ate, count aloud with the children, and encourage the children to pretend to be a caterpillar that eats a given number of food items (Clements & Sarama, 2006b). In some books, the mathematics connection is not so apparent. For example, the book *Blueberries for Sal* by Robert McCloskey, does not have a clear mathematical connection. It does, however, have a little girl who drops blueberries into her pail. In order to embed mathematical concepts into this activity, the teacher can have a pail (a tin can) and blueberries (small magnets). The children can close their eyes and listen as the teacher drops a number of magnets into the tin can. They can hold up fingers to show the number, and then the teacher can dump the can and lead the children in counting the magnets to check their guesses (Clements & Sarama, 2006b).

Wolery (1992) suggests that materials other than books (e.g., rubber stamps, tape players, flannel board sets, magazines, puppets, felt or magnetic letters or numbers, and writing materials) should also be included in the reading and language area. By using these items, teachers can embed math and numeracy concepts such as size, numbers, shapes, and comparisons just as easily as they would embed literacy concepts (Colker et al., 2002). In addition to providing materials that address specific math concepts, children can also begin to comprehend early math and numeracy concepts by selecting a specific number of books, using different sizes of books, using space and patterning, and learning how to make choices (Isbell, 1995).

In 2004, Young-Loveridge conducted a study to examine the effectiveness of an intervention designed to improve children's math/numeracy skills through books and games. The purpose of the intervention was to develop the children's (a) knowledge of number word sequences, (b) ability to form groups, and (c) knowledge of number patterns and numerals. A total of 151 five-year old children (65 girls and 86 boys) who attended low socio-economic status schools in New Zealand participated in the study. About one-sixth of the children at two of the schools participated in the school-based intervention program, and another one-sixth of the participants took part in a home-based intervention program. The remaining two-thirds of the participants were contrast students. Some of the contrast students were in the same classes as those participating in the intervention (within-school contrasts), and some were at two schools (across-school contrasts). Each child participated in a pretest and posttest. Pretests, which assessed counting, pattern recognition, enumeration, numeral recognition, and addition/subtraction were given prior to the intervention. Posttests, which assessed more difficult pretest concepts, were given at the end of the 2-month intervention, 6 months after intervention, and 15 months after intervention. Half of the children were randomly assigned to an intervention group and the other half were assigned to the within-school contrast group. The contrast group continued to learn math with their classroom teachers, but did not participate in the intervention sessions. Participants in the intervention group attended sessions in groups of two for 30 minutes each school day for a 7-week period. During each session, the children experienced number stories, rhymes and games. The games included well-known children's games such as Snakes and Ladders that were shortened and simplified to last for only about 5 minutes. Games with dice were also used in this study. Dice with dot-patterns or numerals up to 3 were initially used. As participant skills increased, dice with larger dot-patterns and numbers were used. Results revealed that playing number games and reading books that included number stories was an effective way to enhance mathematical learning of young children. The specific areas in which the greatest gains were made included number sequencing, stylized number patterns, numeral identification, and grouping objects. Young-Loveridge (2004) concluded that using games and books with small groups of children could in fact improve their math/numeracy skills.

Outdoor Play Area

Outside time is also a very valuable time for learning (Filer, 2008). Although playing outside is often an unstructured time for children, some outdoor activities could and should be planned (Bailey & Wolery, 1992). Piaget (1956) posited that children's motor opportunities within their environment will help them form geometrical perceptions that will be used in their future mathematical learning. Spatial opportunities for math and numeracy development can be embedded into outdoor play in a variety of ways. For example, children can be encouraged to collect different things outside, and then a teacher can facilitate a sorting and classifying activity. This can be taken a step further by assisting the children to graph the items that have been collected (Colker et al., 2002). There are also many shapes and patterns that can be discovered and discussed during outdoor play time such as making patterns out of leaves, discovering the different shapes of swings, slides, and other playground equipment, or using chalk on the sidewalk to draw shapes or make patterns. Other mathematical content areas that may be embedded into outside activities are number concepts and measurement. For example, children can count how many jumps it takes to get from point A to point B, how many times a ball bounces before it stops, or how long or how high a piece of playground equipment is using their feet, hands, or other objects as measurement tools.

Although no empirical research focusing specifically on teaching numeracy and/or mathematics during outdoor play is available, Waite (2007) conducted a study exploring outdoor learning practices. In this study, focus groups were held with 18 children between the ages of 8 and 11 years old. Photographs taken by both the researcher and children were used as stimuli in the focus groups. The participants contributed their views about what they retained from their outdoor learning experiences and the values that they placed upon those experiences. The children who participated in this study indicated that there was a greater appreciation of realism in learning outside the classroom and indicated that hands on experiences were valued. These findings suggest that outdoor play can be a motivating environment in which to incorporate early math and numeracy development for young children.

Cullen (1993) conducted a qualitative research study to explore whether talking and interacting with children about their outdoor play would enhance their learning experiences, encourage more complex and elaborate play, and expose specific cognitive learning that is embedded in outdoor play. Forty children (20 girls and 20 boys) were selected from 10 early childhood centers in Western Australia. All of the children were 5 years of age. Dependent measures included behavioral observation, child interviews, teacher interviews, and field notes of contextual variables that may have influenced the outside play. Results indicated that teachers tend to be more supervisory in outdoor settings and do not have a high degree of interaction with the children. Furthermore, most of the children (62.5%) thought of their outside play as something they did by themselves without help from adults and the majority of the children (82.5%) thought of outside play as a social activity. With prior research pointing toward the idea that cognitive growth in children is promoted by teacher involvement and guidance (Meadows & Cashdan, 1988), it becomes important to consider using similar notions in the outdoor learning environment. Specifically, a free-play outdoor environment, with very limited teacher interaction, may be insufficient in order to achieve academic objectives.

The activity areas discussed thus far are only a few of many that might exist in a preschool classroom. Other areas within the early childhood classroom may include woodworking, discovery, cooking, computers, music and movement, and toys and games. Embedding math and numeracy into these areas can also be accomplished. Many of the mathematical concepts that are embedded into these activities will be the same as those discussed previously. However, the new activities that are presented in each area bring novelty and opportunities for skill generalization.

Although embedding opportunities for the acquisition of math and numeracy skills is necessary, it may not be sufficient. In order to meet the needs of children with disabilities in early childhood settings, it may also be necessary to utilize specific instructional strategies when teaching math and/or numeracy skills. The following section will discuss the use of instructional strategies to support the learning of math and numeracy skills for young children with special needs.

Instructional Strategies to Teach Math and/or Numeracy Skills to Children with Special Needs in Inclusive Early Childhood Settings

Instructional strategies manipulate the environment in order to organize experiences so that children can learn important skills and behaviors (Bailey & Wolery, 1992). Specific instructional strategies that have been empirically validated include stimulus prompts, response prompts, consequences, and prompt fading (Ault, Wolery, Gast, Doyle, & Eizenstat, 1988; Kearney, 2008; Navarro, Marchena, Alcalde, & Ruiz, 2004; Soluaga, Leaf, Taubman, McEachin, & Leaf, 2008). In the following sections, each of these instructional strategies will be defined, evidence demonstrating the effectiveness of these strategies will be presented, and implications as it relates to teaching math/numeracy will be discussed.

Stimulus Prompts

A discriminative stimulus is something that evokes a response from someone or something else (Kearney, 2008). A prompt is an additional stimulus that increases the chances that the discriminative stimulus will evoke the preferred outcome (Alberto & Troutman, 2008). Thus, a stimulus prompt provides alterations within stimuli in order to increase the probability of correct responding (Alberto and Troutman, 2008).

There are two specific types of stimulus prompts. The first type of stimulus prompt is the extra-stimulus prompt. Extra-stimulus prompts are various types of cues (movement, position, redundancy, etc.) that require the child to attend to specific prompts (Wolery, 1988). Extra-stimulus prompts are provided by an interventionist and are commonly used in early childhood settings to teach toy play, speech, social skills, and other behaviors (VanDerHeyden, Snyder, DiCarlo, Stricklin, & Vagianos, 2002). For the purpose of this paper, and to avoid confusion with response prompting techniques, extra-stimulus prompts will specifically refer to an added stimulus that is used in conjunction with the task stimuli or instructional materials (e.g., movement, positioning, or adult interaction) that will guide an individual's response (Schreibman, L., 1975, & Wolery, 1988). For example, consider a child who picks up a remote controlled train and bangs it on a table. An example of an extra-stimulus prompt to teach toy play might include wiggling the button that activates the toy in order to draw attention to how to play with the toy appropriately.

The second type of stimulus prompt is within-stimulus prompting, also referred to as stimulus shaping. Within-stimulus prompting specifically manipulates the critical characteristics of the prompt in order to establish a correct response (VanDerHeyden, Snyder, DiCarlo, Stricklin, & Vagianos, 2002; Wolery, Ault, & Doyle, 1992). An example of a within stimulus prompt may include using a singing voice as a cue that a change/transition is going to happen. For example, a teacher can sing a verbal warning (e.g., "two more minutes until clean-up time") that a transition in the classroom is about to occur. As the target child becomes more proficient in responding during the transition times, the singsong verbal cue can gradually develop into a more typical verbal cue until the child is able to successfully respond to only the verbal warning with no singing tone. A textual within-stimulus prompt may be used to teach a student to sequence simple pictures from left to right. For example, a textual cue (e.g., the word ‘start’ in a bright red star) can be placed on the left side of a sequencing line. As the student becomes more competent in sequencing from left to right, the textual cue can be reduced in size until it does not need to appear at all. Finally, a tactile within-stimulus prompt may be used to teach sorting to a young child. If a child is learning to sort colors (e.g., red and blue), a piece of sand paper can be attached to all of the red objects. The tactile cue (e.g., sand paper) will gradually become smaller until it is absent and the child can successfully meet criterion for sorting red and blue objects.

VanDerHeyden et al. (2002) compared the effectiveness of within-stimulus and extra-stimulus prompts in increasing toy play and opportunities to respond with two young children who attended an early intervention preschool program. The preschool teachers nominated the two participants for this study based on the children’s limited toy play, as well as overall low incidence of play. The first child was a 27-month-old female with a diagnosis of Down syndrome. The second child was a 29-month-old male with a diagnosis of autism. The setting for this study was the children’s classroom, which was divided into activity areas. All of the sessions took place during the child’s activity center of choice. The within-stimulus prompt for this study was toy alterations (e.g., increased level of noise, movement, and light) and the authors referred to the adult prompts (telling the child to engage in a behavior, modeling, physically guiding the child to perform a behavior) as extra-stimulus prompts. The dependent variable for the child with Down syndrome was responses per minute of toy play. The dependent variable for the child with autism was contact with the toy. Results revealed that the child with Down syndrome showed increased play as a result of the extra-stimulus prompt and no increase with the within-stimulus prompt. However, the child with autism showed more variation in his play during the within-stimulus prompt phase, while the extra-stimulus prompting resulted in temper tantrums. These results suggest that individual child characteristics should be considered when choosing stimulus prompts.

In 2004, Navarro, Marchena, Alcalde, and Gonzalo found that using a flashing object on a computer screen as a within stimulus prompt resulted in learning for 64 preschool age children. The computer software that was used in this study was called "Let's Play With…" © and focused on teaching preschool children the basic concepts of shapes and body positions. Participants included 41 boys and 23 girls, all typically developing, between the ages of 35 and 46 months. A between group design was used with an experimental group and a control group. Participants were randomly assigned to one of the two groups. Each group consisted of 32 children. Ten days prior to the beginning of the study, a computer was placed in the children's classroom in order for participants to acclimate to its presence. When the study was initiated, the researcher completed both experimental sessions with every student on an individual basis. The only difference between the experimental group and control group was the presence or absence of a flashing prompt on the computer screen. For example, if there was a picture of two faces on the computer screen, one with open eyes and the other with closed eyes, the computer may ask the child to click on the face with open eyes. The stimulus prompt was the open eyes flashing until the child clicked on the face with open eyes. The dependent measure was the number of errors made by the participant with each item displayed on the computer screen during the individual trials. For the experimental group, the flashing prompt did not appear during the first session and was then incorporated during the second session. The control group did not receive the flashing prompt during either session. A pretest and posttest was administered to the experimental and control group, which showed the mean differences of errors for both groups. In the pretest, the number of mean number of errors for the experimental group was 11.4. For the control group, the mean number of errors was 13.3. In the posttest, the mean number of errors for the experimental group were 2.4 and for the control group, 10.6. In summary, the results of the posttest indicated that the mean number of errors in the sessions without the flashing prompt was significantly higher than in the sessions with the flashing prompt. Therefore, the researchers concluded that the stimulus prompt influenced participant responses (Navarro et al., 2004).

Stimulus prompts can be used to teach a young child early math skills such as number or shape discrimination. For example, a within-stimulus prompt can be used to help a young student learn to identify a particular number symbol or shape. Initially, the teacher can highlight the whole number or shape by tracing it with a brightly colored highlighter marker. Over time, the teacher can trace less and less of the target symbol with the highlighter marker. As the highlighting lessens, and the numbers or shapes look more and more alike, the student will gradually learn and remember how to discriminate the target number or shape. An extra- stimulus prompt may also be used to teach this same skill of identifying a number symbol or shape. An example of using an extra-stimulus prompt to teach this skill may be for the teacher/interventionist to prompt a child to point to a picture of a circle with a positioning cue. The teacher can move the picture of the circle closer to the child than any of the other shapes while asking the child to point to the circle. Over time, the teacher will gradually fade the positional stimulus prompt by moving the circle closer and closer to the other shapes that are being presented to the child.

Response Prompts

Response prompts are teaching procedures during which teacher assistance is presented to students in order to increase the probability of a correct response (Alberto &

Troutman, 2008; Wolery et al., 1992). Response prompts can be given before the student's behavior or following the child's response. Some examples of response prompts include gestural prompts, verbal prompts, pictorial prompts, model prompts, partial physical prompts, and full physical prompts (Wolery et al., 1992). Gestural prompts include nonverbal behaviors such as hand and/or facial movements, for example pointing to the desired answer/response. Gestural prompts are considered nonintrusive because the interventionist does not need to touch the student. Gestural prompts can be used with a single student or with several students at one time (Wolery et al., 1992).

Verbal prompts are vocal statements that tell students how to respond. It is important to note that verbal prompts are not specific directions to let a student know that they need to perform the task, but rather they are statements about how to complete the task. For example, if a student is in charge of preparing the snack table the teacher may use a verbal prompt by saying, "give everybody a napkin". Verbal prompts can be very specific and can describe exactly how to do a task (i.e., get the napkins off of the counter). Verbal prompts can also give a partial directive of how to do a task (i.e., get the napkins), or may even be very indirect (i.e. get something for you and your friends to wipe your hands on). When using verbal prompts it is important to consider the student's capacity to understand the meaning of the verbalization. In addition to being presented to students in proximity, verbal prompts can also be presented to students from a distance (Wolery et al., 1992).

Pictorial prompts are pictures or written messages that inform students how to perform a behavior. Pictures can depict the completed response or provide step-by-step guidance to complete a longer task. Written messages can involve a list of tasks or directions of how to complete an activity. Often times, written messages are paired with pictures. One advantage of pictorial prompts is that they enable a student to complete a task or activity more independently. For example, a picture schedule of the school day can help a preschooler who has trouble remembering the sequence of activities (Wolery et al., 1992).

Model prompts are a demonstration of how a behavior should be performed. It is important to make sure that the model is exactly like the expected behavior. For example, if the target behavior is a motor/physical response, then the model should be that exact motor/physical behavior. If the target behavior is verbal, then the model should be verbal. Model prompts do not require physical contact with the students. However, before using model prompts, it is important to determine if the student is imitative. If the student is not imitative, the model prompt will most likely be ineffective (Wolery et al., 1992).

Partial physical prompts involve a teacher physically touching a student, but not completely controlling their movements. Partial physical prompts may include, but not be limited to, gentle and slow pulling or pushing in order to set the target behavior in motion. For example, a teacher may prompt a student to move their arm forward by gently pushing on their elbow in order to help them participate in a turn taking activity of putting objects into a container. Partial physical prompts can be used to cue a student to begin an activity, as well as to cue a student to engage in a particular behavior. Partial physical prompts are very short prompts, and are often paired with other prompting strategies such as verbal and gestural prompts in order to ensure success for the student. An example of pairing a partial physical prompt with a verbal prompt may occur when a young child is learning to sort pictures of animals that go in the zoo or on the farm. The teacher can say, "pig goes on the farm" and at the same time gently nudge the student's arm in the direction of the farm.

Full physical prompts involve a teacher making physical contact with the student and fully controlling the student's movements. For example, the teacher may place her hands on or under a student's hands in order to completely move them through the target behavior. The teacher has complete control over the students' responses, therefore lessening the chance for error. Full physical prompts are often paired with other types of prompts, and are considered an intrusive type of prompt. It is important when using full physical prompts to be careful not to hurt the student by forcing a movement that is not possible or by holding a student too tightly (Wolery et al., 1992).

In summary, response prompts can include gestures, verbalizations, pictures, written words, models, and physical guidance/support. It is important for the teacher/interventionist to determine which type of response prompt is most appropriate with the student prior to implementation. Furthermore, it is possible to combine different types of response prompts, and with the exception of full and partial physical prompts, response-prompting strategies can be used with one or several students at once (Wolery et al., 1992).

Consequences and Reinforcers

When a teacher or interventionist is preparing to implement an intervention strategy, they must also consider what type of feedback or consequence will be provided. Alberto and Troutman (2008) describe the term consequence as any introduced stimulus that is dependent of a specific response, and define reinforcer as a "consequent stimulus that increases or maintains the future rate and/or probability of occurrence of a behavior" (Alberto & Troutman, 2008, p. 497). A natural consequence is often enough reinforcement for individuals to choose to do things or to perform specific behaviors. However, when a teacher is trying to change a student's behavior, more powerful reinforcement, in addition to natural consequences, may be necessary. When teaching a new behavior, a student's response can be either correct or incorrect. The following paragraphs will discuss feedback for both correct and incorrect responses.

Positive reinforcement is used to reward a student's correct response, and may consist of tangible (e.g., certificates, badges, stickers, balloons, etc.), edible (cracker, juice, etc.), sensory (e.g., stroking the students face with a soft puppet, listening to music, etc.), or generalized reinforcers (e.g., tokens, points, credits, etc.) (Alberto & Troutman, 2008; Stevens & Lingo, 2005). Bailey and Wolery (1992) discuss several guidelines for using reinforcers. First, the correct response should be clearly specified. For example, if a child's target behavior is to sequence three numbers it needs to be specified that they need to be three consecutive numbers (e.g., 1, 2, 3) and not any three numbers sequenced smallest to biggest (e.g., 3, 8, 12). Second, the reinforcer needs to be delivered immediately following the correct response in order to increase the likelihood of the child repeating the desired behavior. Third, if tangible reinforcers are used, they should be paired with social reinforcers in order for the social stimuli to eventually become the reinforcer. This is important because social reinforcement (e.g., praise, appropriate touching, hugs, etc.) can occur in various settings, can be adapted to the natural environment, and is the most natural consequence for behavior. Finally, when possible, a variety of reinforcers should be used in order to increase motivation and to keep a single reinforcer from losing its effectiveness.

A correction procedure, which is preplanned by the interventionist, follows an incorrect response and guides the student to the correct response (Stevens & Lingo, 2005). When a child responds incorrectly or inappropriately, the behavior should not result in reinforcement (Bailey & Wolery, 1992). Also, it is important to note that studies on various types of feedback suggest that, when feedback is given, it should include the correct response/answer, as opposed to only indicating that the response is incorrect (Fazio, Huelser, Johnson, & Marsh, 2010; Pashler, Cepeda, Wixted, & Rohrer, 2005; Roper, 1977). For example, if a child provides an incorrect response by placing two sequential pictures of a bedtime routine in the wrong order, the teacher can respond by saying, "No, that is incorrect. You need to brush your teeth *before* you get in bed". In summary, children need to receive feedback in order to learn when and where behavior should occur (Bailey & Wolery, 1992). It is very important for the interventionist to decide what the consequence and feedback will be for both correct and incorrect responses.

Prompt Fading

In addition to considering the use of stimulus prompts, response prompts, and consequences, it is important to consider how prompts will be faded in order to allow for a more natural stimulus to prompt the desired behavior (Kearney, 2008). Constant and progressive time delay, the system of least prompts, and a most-to-least prompting hierarchy are useful strategies for prompt fading (Wolery, Ault, Doyle, & Gast, 1986). In the following sections, these strategies will be discussed, followed by a review of several comparison studies of prompt fading methods.

Progressive and Constant Time Delay

Walker (2008) describes time delay as a method to shift stimulus control by using varying amounts of time between the natural cue and a more controlling prompt (e.g., physical prompt, verbal prompt, gestural prompt, etc.). There are two types of time delay, constant and progressive. When using constant time delay (CTD), the facilitator initially presents a target stimulus at the same time as a controlling prompt. The child is given the opportunity to respond for a specific number of trials and correct responses are reinforced. As the trials proceed, the interval between the target stimulus and the prompt is increased for a fixed number of seconds (Bailey & Wolery, 1992). Trials may be zero-second trials or delay trials. Zero-second trials have no time between the task request and the controlling prompt, as opposed to a delay trial that has a specified time (e.g., 4 seconds) between the task request and the controlling prompt (Stevens & Lingo, 2005). A second type of time delay is progressive time delay. Progressive time delay is very similar to constant time delay, with the only difference being that the interval between the task request and the controlling prompt is gradually increased (Bailey & Wolery, 1992). For example, the interventionist may provide a prompt immediately following the task request when the child is initially learning a new skill. As the child becomes more proficient in performing the skill, the interventionist will gradually increase the time between the task request and prompt. If the child does not respond to the target stimulus, or responds with an incorrect response during either type of time delay strategy, there is no reward or reinforcement given to the child. This results in limited response errors or prompted errors (Wolery et al., 1992).

Time delay can be used to fade stimulus and response prompts, and has been shown to be effective in teaching children with disabilities a wide range of skills including communication skills, social skills, play skills, pre-academic and academic skills, and self-care skills (Cybriwsky & Schuster, 1990; Snell, Lewis, & Houghton, 1989; Stevens & Schuster, 1987; Wolery et al., 1992; Yilmaz et al., 2005). Venn and Wolery (1992) evaluated the effectiveness of progressive time delay in teaching three preschoolers with disabilities to imitate their peers during art activities. All of the students were enrolled in a half-day, mainstreamed program designed for children with autism. No more than three typical peers and one child with disabilities were at the art table at one time. Five teachers were trained to conduct peer-mediated trials, which were embedded into each child's daily art activities. Four possible responses for each trial were measured. The responses included unprompted full imitation, prompted imitation, approximation, and error or no response. The children's actual participation (e.g., amount of time spent engaged, waiting or nonengaged during the activity) was also measured (Venn & Wolery, 1992). In order to assess the effects of the progressive time delay procedure, a multiple probe design across subjects was used. Two types of trials, 0 second and delay, were used during the progressive time delay condition. For the 0 second trials, the teacher said "(student's name), see what (peer's name) is doing. You do it." The teacher then immediately provided a full physical prompt. During the delay trials, a 2 second response interval was implemented after three consecutive sessions at 0 second, 2 seconds, 4 seconds, and stopping at 6 seconds. The teacher used the same verbal cue, but also provided the appropriate response interval. The results of this study showed that the progressive time delay procedure produced high levels of peer imitation within all of the art activities (Venn & Wolery, 1992).

Wolery et al. (2002) evaluated the effectiveness of constant time delay when teaching identified target behaviors for each participant. The participants were three boys, ages 5 to 8 years, who were attending an inclusive summer day camp. One of the boys had a history of problem behaviors, and the other two boys had identified disabilities that included developmental delays and attention-deficit/hyperactivity disorder. The design used in this study was a multiple probe across behaviors, replicated across participants. The researchers conducted probe sessions with each child individually and in a separate classroom from where other activities were being held. Instructional trials were completed by the camp director and the teachers and were embedded into the morning circle time and/or transitions. Prior to the start of the study, all of the participants were screened in order to identify eight unknown stimuli, which were then divided into four behavior sets for each child. The target behaviors that were taught included (1) orally reading sight words for colors and numbers, (2) orally reading sight words selected from Dolch Basic Sight Words, and (3) orally stating the product of multiplication problems. The interventionists used constant time delay to conduct eight trials per day. The constant time delay procedure involved one day of 0 second trials followed by 4 second delay trials. The criterion for acquisition was 100% on 2 of 3 days with unprompted correct responses. Results revealed that constant time delay resulted in all three children acquiring the instructed behaviors. All of the participants were also able to generalize the responses across adults and material. Maintenance occurred with all three participants, however they showed decreases in correct responses during probe sessions that occurred late in the study (Wolery et al., 2002).

Following a review of 22 empirical studies examining the use of both constant and progressive time delay procedures used specifically with children with autism, Walker (2008) suggested that both time delay procedures are similar in their effectiveness, with constant time delay resulting in slightly more errors to criterion, a greater amount of procedural modifications, and in a slightly delayed transfer of the stimulus control. However, Dogoe and Banda's (2009) review of research from 1996-2006 revealed that skills learned with constant time delay procedure did generalize across settings, persons, and materials.

In summary, research supports the use of the both constant and progressive time delay to teach a range of behaviors and it seems probable that these time delay procedures could be used to teach math/numeracy skills. Examples of the use of constant and progressive time delay to teach math/numeracy skills are illustrated in Table 2. Table 2 shows how a constant time delay strategy can be used in the arts and crafts center to teach a young child to label and point to a shape when asked. Table 2 also illustrates the use of a progressive time delay strategy in the reading and language center to teach a child to label and point to a number when asked.

System of Least Prompts

The system of least prompts (SLP) is a response prompting procedure in which increasing assistance is provided by starting with the discriminative stimulus which gives the participant the information about what they need to do, adding the least intrusive prompt, and then giving the student the opportunity to respond (Alberto & Troutman, 2008). The system of least prompts can be used to fade response prompts, as well as stimulus prompts (Wolery et al., 1992; Wolery, Gast, Kirk, & Schuster, 1988). When using this technique, it is very important to not sound harsh or irritated during a least to most prompting strategy (Alberto & Troutman, 2008). If the student provides an incorrect or no response, the interventionist gradually increases the intrusiveness of the prompt until the student emits a correct response. Several empirical studies have evaluated the effectiveness of the system of least prompts in teaching a variety of tasks such as telephone skills, cooking, and reading sight words to students with disabilities (Doyle, Wolery, Gast, Ault, & Wiley, 1990; Manley, Collins, Stenhoff & Kleinert, 2008; Mechiling, Gast, & Fields, 2008). The studies have shown that SLP is an effective way to teach a range of skills to students with disabilities. In addition, participants are able to maintain the ability to perform the target skills over time (Doyle et al., 1990; Manley, Collins, Stenhoff &Kleinert, 2008; Mechiling et al., 2008). Generalizing the skills, however, appears to be a more difficult task for the students (Manley, Belva, Stenhoff,

Table 2. Example of a zero-second constant time delay and progressive time delay procedure

INTERVENTIONIST ANTECEDENT	STUDENT RESPONSE	INTERVENTIONIST FEEDBACK
Zero-Second Constant Time Delay Procedure		
• The interventionist chooses the arts/crafts center for the intervention. • "Maya, let's play shapes!" • Show cutout paper shape (e.g., circle), make sure Maya is paying attention, and immediately give the controlling prompt (e.g., point to the shape and say "circle").	• Correct Response: Responds correctly by imitating prompt (e.g., points to the shape and saying "circle"). • Incorrect Response: Responds incorrectly after the prompt by failing to imitate correctly (e.g., points to the shape and says "square").	• Feedback for Correct Response: "Yes! This is a circle." Help Maya glue the circle onto a piece of paper. • Feedback for Incorrect Response: Points to the circle and says, "No, this is a circle. What is this?" (Allow the child to imitate the repeated controlling prompt.) Continue this process until Maya successfully points to the circle, and says, "circle".
Progressive Time Delay Procedure		
▪ The interventionist chooses the reading and language center for the intervention. ▪ "Eric, let's name numbers!" ▪ Show number (e.g., number 1), make sure Eric is paying attention, and immediately give the controlling prompt (e.g., point to the number and say "one").	▪ Correct Response: Responds correctly by imitating prompt (e.g., points to number and says "one"). ▪ Incorrect Response: Responds incorrectly after the prompt by failing to imitate correctly (e.g., points to the number and says "five").	▪ Feedback for Correct Response: "Yes! This is number 1. Allow Eric to mark on a piece of paper with a vibrating pen. Fade by requiring more responses between reinforcement, and/or removing batteries to eliminate vibration. ▪ As the child continues to respond correctly and meets prespecified criterion, the interventionist gradually increases number of seconds between the task request and controlling prompt (e.g., 3 sec., 6 sec., etc.) until controlling prompt is no longer needed. ▪ Feedback for Incorrect Response: "No, this is number 1. What is this?" (Allow the child to imitate the controlling prompt at zero-second delay until child meets prespecified criterion. Repeat this step for incorrect answers at each progressed time delay (e.g., 3 sec., 6 sec.).

& Kleinert, 2008).

In summary, research supports the use of the system of least prompts to teach a range of behaviors and it seems plausible that the system of least prompts could be used to teach numeracy/math skills. An example of using the SLP procedure with a response prompt strategy to teach shapes is illustrated in Table 3.

Most-to-Least Prompting

A most-to-least prompt hierarchy starts with the most powerful or controlling prompt that will almost guarantee that the student will deliver the correct response. The amount of assistance is then gradually decreased as the student becomes more proficient in the requested skill (Alberto & Troutman, 2008). Research has revealed that most-to-least prompting is effective in teaching, maintaining, and generalizing behaviors (Batu, Ergenekon, Erbas, & Akmanoglu, 2004; Vuran, 2008).

Batu et al. (2004) conducted a multiple probe design study across behaviors to examine the effectiveness of most-to-least prompting when teaching pedestrian skills (e.g., crossing the street) to students with developmental disabilities. The participants included five males with developmental disabilities, including limited communication skills, ranging in age from 7 to 15 years. The researchers developed a task analysis for each pedestrian skill instruction. The three pedestrian skills taught were all related to crossing the streets, and included both one way and two-way roads. In this study, the method of most-to-least prompting included doing the skill with a verbal and full physical prompt for six sessions, followed by a verbal and partial physical prompt for six sessions. After six sessions of a verbal and partial physical prompt, only verbal prompts were used. However, none of the participants needed only a verbal prompt because all participants successfully performed all

Table 3. Example of system of least prompts

INTERVENTIONIST ANTECEDENT	STUDENT RESPONSE	INTERVENTIONIST FEEDBACK
• Interventionist chooses the arts/crafts center for the intervention. • “Maya, let’s play shapes!” • Show cutout paper shape (e.g., circle, square, and triangle), make sure Maya is paying attention, and immediately give the controlling prompt (e.g., say “point to the circle”).	• Correct Response: Responds correctly by pointing to the circle. • Incorrect Response: Responds incorrectly after the prompt by pointing to a cutout paper square.	• Feedback for Correct Response: “Yes! This is a circle!” Interventionist helps Maya glue the circle to a piece of paper. • Response to first incorrect answer: “No, “remember, circles are round” (Allow the child to respond to the prompt.) • Response to second incorrect answer: Pair gestural prompt of pointing to the circle when saying, “point to the circle”. • Response to third incorrect answer: Use a full physical prompt (e.g., place the child’s finger on the circle) when saying, “point to the circle”.

of the skills independently after the verbal and partial physical prompt. The results of this study indicated that most to least prompting is effective in teaching pedestrian skills. Each of the participants learned all of the pedestrian skills, and was able to generalize the skills in actual city traffic during future daily occurrences (Batu et al., 2004).

In summary, most-to-least prompting is an effective strategy to teach individuals various skills and tasks, and can be used with both response prompts, as well as with stimulus prompts. It seems plausible that the most-to-least prompting strategy could be used to teach math and numeracy skills. For example, when using a response prompt to teach a young child to sequence the number symbols 1, 2, and 3, the interventionist may pair a verbal request (e.g., “let’s put the numbers in order, 1…2….3.”) and simultaneously use a full physical prompt by moving the child’s hand in order to place the number cards in sequential order. Once the child reaches criterion with the full physical prompt, the interventionist can continue to give the verbal request paired with the next most controlling prompt (e.g., partial physical, gestural, etc.) until the child can place the number cards in order with only the verbal request. Another example can be seen when using a within stimulus prompt to teach a young child one-to-one correspondence for the number 3. Initially, three circles can be drawn in bold marker directly under the number 3. As the child continues be successful, the lines of circles can become lighter and lighter until the visual prompt no longer exists.

Comparison Studies of Prompt Fading Strategies

Several empirical studies have compared the effectiveness and efficiency of various prompt-fading strategies (Ault et al., 1988; Doyle et al., 1990; Miller & Test, 1989; Wolery, 1990). The following paragraphs summarize studies that compared the effectiveness of constant time delay, system of least prompts, and most to least prompting strategies.

Ault et al. (1988) compared the effectiveness and efficiency of constant time delay (CTD) and system of least prompts (SLP) in teaching young students to name numerals. The participants included two male students, both 8 years of age, diagnosed to be within the autism spectrum. Two instructional sessions occurred each day. One session focused on CTD and the other session focused on SLP. Two pairs of numerals were taught each day, one during each session. Each session consisted of 20 trials, including two trials on previously known stimuli. A parallel-treatments design was used in order to evaluate the CTD and SLP response prompt procedures. Results revealed that both the CTD and SLP response prompt procedures were effective in teaching numeral identification to students with autism. Both participants learned eight numerals with the CTD and with SLP, resulting in a total of 16 newly learned numerals. Sessions, trials, percentage of errors, and direct instructional time were recorded. Results indicated that CTD was more efficient than SLP, requiring 72% of the time required by SLP (Ault et al., 1998). In 1990, two additional studies were conducted to compare the system of least prompts (SLP) and constant time delay (CTD) (Doyle et al., 1990; Wolery, 1990). Both prompting strategies in both studies resulted in criterion level performance. However, constant time delay procedure was more efficient in terms of the number of trials, instructional time, and more errorless learning. In summary, various empirical investigations have demonstrated that although both CDT and SLP are an effective response prompting techniques, CTD may be more efficient (Doyle et al., 1990; Manley, Collins, Stenhoff, Kleinert, 2008; Mechiling, Gast, Fields, 2008; Wolery, 1990).

Miller and Test (1989) compared the effectiveness and efficiency of constant time delay and most-to-least prompting. Laundry skills (e.g., operating the washing machine and dryer) were taught to four 18 year olds with moderate mental retardation. During the most-to-least prompting strategy, three specific prompts were used. The first, and most intrusive, prompt was direct verbal and physical assistance. The second prompt was a direct verbal prompt paired with a gesture. The third, and least intrusive, was an indirect verbal prompt (e.g. “What do you do now?”). There were two phases during the CTD strategy. The first phase included a 0 second time delay, during which the interventionist simultaneously provided a prompt during each step of the laundry task. The second phase of CTD was implemented after the student completed three consecutive correct sessions in phase one. During the second phase, a 2 second time delay was provided between each step in the laundry task. If the student did not initiate the desired step within 2 seconds, the interventionist provided the appropriate prompt (the level of prompt was selected for each student with the help of the classroom teacher and remained consistent throughout all of the sessions). The sessions continued until each participant performed three consecutive correct responses during the probes. The results revealed that both the constant time delay and most-to-least prompting technique were effective in teaching this laundry task. However, the constant time delay procedure was more efficient in terms of instructional time and errors.

In summary, it is important to note that prompt fading is critical when teaching new math/numeracy skills. Since skills are often presented in a building block series, it will be difficult to teach the next skill if a prompt is not faded. For example, if a child is learning to identify numbers through the use of prompts, those prompts will need to be faded before teaching subsequent skills such as counting, adding, subtracting, and so on.

Summary

Statement of the Problem

Mathematics and numeracy are valuable cognitive learning areas that need to be addressed during the early childhood years. National entities are now acknowledging the importance of early math/numeracy learning, and have developed standards related to math/numeracy (National Association for the Education of Young Children, 2005; The National Council for Teachers of Mathematics, 2005). Children start to learn concepts related to math/numeracy from their first year of life (Clements, DiBiase, & Sarama, 2004). However, children’s abilities for learning mathematics at an early age are not well recognized. Efficient and effective strategies need to be investigated so that all children, including those with disabilities, have opportunities to be successful learners of mathematics. This literature review discussed (a) ways to create and embed opportunities for learning math/numeracy skills across a range of different learning centers and (b) empirically validated instructional strategies for teaching new skills/behaviors.

Research Questions

The purpose of this study was to investigate the effectiveness and efficiency of using a specific intervention strategy to teach numeracy/math skills to young children with special needs participating in inclusive preschool environments. The hypothesis was that numeracy/math skills could be successfully taught to children with disabilities, using empirically validated instructional strategies, within the context of inclusive early childhood settings. The present study addressed the following research questions:

1. Is an intervention strategy comprised of creating opportunities, prompting, providing consequences, and prompt fading effective in teaching preschool children with disabilities numeracy/math skills in the context of identified classroom activities?
2. How do preschool staff rate the acceptability and perceived effectiveness of the use of the strategy?

CHAPTER 2

METHODS

This study used a single subject multiple-baseline probe design within participants, replicated across participants, to explore the effectiveness of an intervention strategy designed to teach three preschool-aged children with disabilities numeracy/math skills in the context of their inclusive classroom settings. The Institutional Review Board (IRB) at the University of Utah, USA as well as the IRB for the participants' preschool program approved this study.

Participants

Three preschool-aged children, Elizabeth, Steven, and Jill (pseudonyms), were chosen to participate in this study. Together, the early childhood director, classroom teachers, and researcher identified all three participants, as children that were ready to learn the identified numeracy/math skills. Participants were between the ages of 4 and 5 years, and attended an inclusive early childhood program. All participants had a documented developmental delay, Individualized Education Plan (IEP), and were receiving special education and related services (e.g., speech therapy, occupational therapy, etc.). Participants had normal (or corrected to normal) vision and hearing. Demographic information for each participant was obtained from the child's file. The numeracy/math skills taught to each participant were chosen based on the results of the math section of the High Scope

Assessment (Brickman & Barton, 2003), as well as the results of The Brigance Inventory of early Development (IED-II) (Brigance, 2010), which has a skill area that focuses on basic mathematical concepts. (See Appendix D for a summary of the numeracy/math skills assessed by each of these developmental tools.) The numeracy/math skills chosen for each participant included three related behaviors (e.g., identification of three different numbers, identification of three different shapes) that could be physically prompted (e.g., rote counting cannot be physically prompted). Table 4 summarizes demographic information, assessment data, and numeracy/math goals/objectives across participants.

Setting

All baseline, intervention, maintenance, and generalization sessions occurred during free choice time activities in three, public and inclusive preschool classrooms located in a metropolitan area. Two of the classrooms were Head Start preschool programs and the third classroom was part of the public school district. In inclusive settings, the ratios of children with disabilities to typically developing children vary across programs. However, researchers and practitioners most often use the term *inclusive* to refer to settings in which the majority of the children are typically developing (Odom & Diamond, 1998). The settings in which the current study took place conformed to this definition.

The first classroom was comprised of 15 children, three of whom received special education services. Two adults staffed this classroom. One adult had a bachelor's degree in Early Childhood Education and the other had a master's degree in Elementary Special Education. In addition to these two adults, a special education specialist, speech language pathologist, physical therapist, and occupational therapist served as classroom consultants.

The second classroom was comprised of 16 children, 4 of whom received special

Table 4. Demographic information

Demographic Information	Participant 1 "Elizabeth"	Participant 2 "Steven"	Participant 3 "Jill"
Age	4 years 2 mos.	4 years 7 mos.	4 years 9 mos.
Gender	Female	Male	Female
Diagnosis	Developmental Delay, Chiari Malformation	Developmental Delay, Cerebral Palsy, Seizure Disorder	Developmental Delay, Seizure Disorder, Hypotonia
Services currently being received	Special Education, Speech & Language Therapy	Special Education, Speech & Language Therapy, Physical Therapy	Special Education, Speech & Language Therapy, Physical Therapy, Occupational Therapy, vision services
Current Developmental Age Across Domains (Based upon results of the Brigance Developmental Inventory)	**Gross Motor:** 4 years **Fine Motor**: 4 years **Self Help:** 4 years **Speech/Language**: 3.4 years **Cognitive**: 3.4 years **Social Emotional** 3.4 years	**Gross Motor**: 3.2 years **Fine Motor:** 4 years **Self Help**: 4 years **Speech/Language**: 3.6 years **Cognitive**: 3.8 years **Social Emotional**: 4 years	**Gross Motor**: 2 years **Fine Motor**: 3 years **Self Help**: 2 years **Speech/Language**: (Exp) nonverbal, (Rec) 3 years **Cognitive**: 2.6 years **Social Emotional**: 2.6 years
Math Goal and Objectives	Goal: Point to number symbols upon request Objectives: To point to numbers 2, 3 and 4 upon request	Goal: Point to number symbols upon request Objectives: To point to numbers 6, 7 and 9 upon request	Goal: Point to shapes upon request Objectives: To point to diamond, rectangle, and triangle upon request
Prior experience with direct teaching of math skills (yes or no)	No	No	No

education services. Two adults staffed this classroom. One adult had an associate's degree in Psychology. Both teachers had early childhood education work experience and also received ongoing continuing education in the area of early childhood education. In addition to these two adults, a special education teacher, speech language pathologist, physical therapist, and occupational therapist served as classroom consultants.

The third classroom was comprised of 17 children, 4 of whom received special education services. Two adults staffed this classroom. One adult had an associate's degree in Early Childhood Special Education and was pursuing her bachelor's degree in Early Childhood Special Education. The second adult had a Child Development Credential (CDA). In addition to these two adults, a special education specialist, speech language pathologist, physical therapist, and occupational therapist served as classroom consultants.

In each of the classrooms, free choice activities were conducted for approximately 1 hour of the 2 ½ or 3 hour preschool day. During this time, children were allowed to move freely among seven developmentally appropriate learning centers. The learning centers included a block center, house area, art center, reading and writing center, sand and water center, science center, and a computer area. All study activities were embedded into one learning center in each participant's classroom. The learning center for each participant was chosen based upon teacher report of child preferences and remained the same throughout baseline, intervention, maintenance, and generalization.

Interventionist

The author, who has a master's degree in Early Childhood Special Education, served as the interventionist for all participants. The interventionist had 15 years of professional experience in early childhood classrooms, working specifically with children with disabilities. The interventionist joined existing preschool classroom activities in order to implement the intervention. She embedded opportunities for the participants as well as peers who were engaged in the same activity center. However, when interacting with peers, the interventionist presented opportunities that were not related to the skill being taught to the participant (e.g., if the target skills for a participant were to identify the number symbols 1, 2, and 3, then the opportunities provided to peers were to identify the numbers 4 and 5). This helped control for the variable of incidental opportunities for learning for the study participant.

Materials

The materials used in this study included the props that were available in the identified activity center. For Elizabeth, props in the writing center included paper, stamps, stickers, and pencils. For Steven, props in the block center included large wood blocks, a toy car, a toy train, and a simple racetrack. For Jill, props in the art center included different types of paper, markers, crayons, scissors, glue, and stickers.

In order to embed opportunities to teach the target skills (e.g., number or shape identification), the interventionist introduced additional materials into each center. For Elizabeth (whose intervention was embedded into the writing center), the number symbols 1-5 were printed in black, 72 comic sans font on 1”x1” pieces of white paper and attached with Velcro to wood stamps. For Steven (whose intervention was embedded into the block area) the number symbols 6-10 were printed in black, 72 comic sans font on 1”x1” pieces of white paper and attached with Velcro to wooden blocks. Finally, for Jill (whose intervention was embedded into the art center), shapes (diamond, triangle, circle, square, and rectangle) that were approximately 1 ½”x 2” were printed in purple ink onto white paper, and then painted with sparkles. The materials for any given participant remained the same during all baseline, intervention, and generalization opportunities.

In order to ensure that the participants did not use position as a cue for learning, the interventionist created a notebook of templates for each participant. The templates were used to cue the interventionist on the placement of the numbers/shapes for each opportunity. On each template, the array of five numbers/shapes was presented in different orders and configurations (e.g., row, column, random). The templates were printed on 8 ½" x 11" pieces of white paper, which were then placed in a three ring binder. Eight different templates were created, each being copied three times to make a total of 24 pages of templates for each participant.

Data Collection

Acquisition

Data to measure the identified numeracy/math skills for each participant were collected during baseline, intervention, maintenance, and generalization sessions. Each of the children attended an early childhood classroom 4 days per week. Data reflect five opportunities per session with one to two sessions per day. The interventionist used a coding sheet to collect data on participant behaviors (Appendix A). Data collection for all three participants was completed in 4 months.

Current Staff Beliefs Regarding Numeracy/Math in Preschool

In order to obtain information regarding preschool staff's values/beliefs related to teaching numeracy/math in early childhood classrooms, eight staff members completed an anonymous questionnaire prior to the study (Appendix B). The questions were based on the results of a study conducted by Lee and Ginsburg (2009), which identified nine misconceptions related to teaching mathematics in early childhood classrooms. These misconceptions included the belief that (a) children are not ready for learning about mathematics, (b) mathematics is only for the smartest children, (c) introducing simple numbers and shapes is enough, (d) language and literacy are more important than mathematics, (e) teachers need to provide an enriched physical environment and simply let children play, (f) mathematics should not be taught as a subject matter, (g) assessment in mathematics is inappropriate for preschool children, (h) children only learn mathematics through the use of concrete objects, and (i) computers are inappropriate for teaching mathematics to young children.

Social Validation

Data to assess the acceptability and perceived effectiveness of the use of the intervention was collected through a 19 item questionnaire adapted from a survey by Johnston, Davenport, Kanarowski, Rhodehouse, & McDonnell (2009) (Appendix C). Prior to completing the survey, staff members had observed two sessions from each phase of the study (e.g., baseline, intervention, maintenance, and generalization). Four of the six classroom teachers completed the social validation survey.

Procedures

Throughout the duration of the study, no participants chose to leave the identified activity center during any baseline, intervention, maintenance, or generalization sessions. The duration of sessions ranged from 5-15 minutes. In order to control for incidental opportunities for learning, the classroom curriculum was considered to ensure that the target numeracy/math skill was not going to be addressed at the same time that it was taught to the participant.

Creating opportunities

During all baseline, intervention, maintenance, and generalization sessions, the interventionist embedded opportunities to measure and/or teach the identified numeracy/mathematics skills. As mentioned previously, the target skill for Elizabeth was to point to the number symbols 2, 3, and 4. In order to create opportunities, the interventionist told Elizabeth that they were going to work together to stamp a piece of paper. During any given opportunity, the interventionist placed the array of five stamps, with the number symbols attached, on a template in the notebook. The interventionist then prompted Elizabeth to point to the stamp with the stated target symbol. Across opportunities, the interventionist turned the pages of the notebook containing the templates in order to ensure that the stamps were presented in different configurations. During noninstructional opportunities, Elizabeth was free to play with and use any of the available stamps.

The target skill for Steven was to point to the number symbols 6, 7, and 9 (prestudy assessment revealed that Steven already knew the number symbol “8”). In order to create opportunities, the interventionist told Steven that they were going to work together to build a block tower. During any given opportunity, the interventionist placed the array of five blocks, with the number symbols attached, on a template in the notebook. The interventionist then prompted Steven to point to the block with the stated target symbol. Across opportunities, the interventionist turned the pages of the notebook containing the templates in order to ensure that the blocks were presented in different configurations. During non-instructional opportunities, Steven was free to use any of the available blocks.

The target skill for Jill was to point to the shapes diamond, rectangle, and triangle. In order to create opportunities, the interventionist told Jill that they were going to work together to decorate a shaker made out of a folded paper plate that was stapled together and filled with rice. During any given opportunity, the interventionist turned to the template in the notebook and prompted Jill to point to the stated target shape. Across opportunities, the interventionist turned the pages of the notebook containing the templates in order to ensure that the shapes were presented in different configurations. During non-instructional opportunities, Jill was free to use any of the available art materials.

Prompting the desired behavior

The interventionist established physical proximity and attention with the child. She then simultaneously presented a verbal task demand and prompted the child to perform the desired behavior. For example, when prompting the desired behavior with Steven, the interventionist made the verbal task demand; "Steven, point to the number 6" while simultaneously physically prompting Steven to point to the number 6. The interventionist used a most-to-least prompting strategy across opportunities, which progressed from a full physical prompt (i.e., hand-under-hand) paired with the verbal task demand, to a partial physical prompt (i.e., gently nudging the participants elbow to prompt the movement to point to the object) paired with the verbal task demand, and finally to only the verbal task demand. A most-to-least prompting strategy was chosen because this strategy has been shown to result in rapid acquisition of target behaviors (Bailey & Wolery, 1992). Further, the participants in this study were preschoolers (e.g., 4-5 years of age) who may have become restless and disruptive unless the controlling prompt was presented at the beginning of the prompt hierarchy (Bailey & Wolery, 1992). When a participant correctly engaged in the target behavior for four out of five opportunities across three consecutive sessions, the interventionist moved to the next least controlling prompt (e.g., full physical to partial physical).

Providing consequences

If the child emitted a correct response, the interventionist provided verbal feedback, including information regarding why the response was correct (e.g., "Yes, you're right! That is the number 6!"), as well as a natural consequence that was part of the activity (e.g., adding the block to a block tower). If the child emitted an incorrect response, the interventionist verbally provided feedback, including information regarding the desired response (e.g., "No, THIS is the number 6", while pointing to the block with the number 6 on it). The interventionist then repeated the request for the target behavior and provided the next higher prompt in the hierarchy. This continued until the child emitted the correct response.

Experimental Design

This study used a single-subject multiple-baseline probe design within participants consisting of three phases: baseline, intervention, and maintenance. In addition, generalization probes were conducted in order to examine the use of the target skill in the context of the same activity but with a different adult (e.g., classroom teacher). Experimental control was demonstrated when there was a positive change, from baseline performance, in the trend of the measured skill that was contingent on the introduction of the intervention (Kazdin, 1982). The ability to focus interest on the changes in the performance of each participant was a main advantage to using the within subjects design (Keppel, 1991). By using this design, the dependent variable (e.g., numeracy/math skill) was free to vary across participants and allowed the researcher to combine collected data across individual cases (Hilliard, 1993).

Baseline probes

Baseline data were collected to measure participant behavior prior to implementation of the intervention for each of the three related numeracy/math behaviors. During baseline, the interventionist embedded five opportunities per session for the participant to demonstrate the desired behavior. Participant responses were recorded for each opportunity. The interventionist presented the verbal task demand, but did not provide prompts or consequences during baseline. When data across three to five consecutive sessions showed a stable or worsening (e.g., decreasing) pattern for skill number one, the intervention phase for this skill began. The interventionist continued to collect baseline probe data for skills two and three during the intervention phase for skill number one. When there was a positive shift between baseline and intervention data for skill number one, and the participant met baseline criterion for skill number two, intervention for skill number two was introduced. The interventionist continued to collect baseline probe data for the third numeracy/math skill. When the participant demonstrated a positive shift in number of correct responses between baseline and intervention for the second target skill, and baseline criterion for skill number three was met, intervention for skill number three was introduced.

Intervention

Intervention data were collected to measure the effects of the intervention. Intervention sessions occurred in the same activity center as baseline. During the intervention phase, prompts and consequences (discussed in prior sections) were provided to the participant. Five opportunities to practice the target numeracy/math goal were embedded into each session. Criterion for mastery of the desired behavior was defined as four out of five unprompted correct responses (e.g., 80% correct response) across three consecutive sessions

Maintenance probes

When a participant met criterion for mastery of the desired behavior (see above), the maintenance phase began. Maintenance probes were administered in order to determine if learned skills were maintained over time. Maintenance probes began one week after the child met criterion for each targeted skill and continued for the duration of the study. Maintenance probes were conducted in the same activity center and used the same materials that were used during the intervention sessions. During maintenance sessions, five opportunities for each target skill were embedded into the activity. The participant was not provided with prompts or consequences during the maintenance probes.

Generalization probes

Generalization probes for each numeracy/mathematics skill were implemented during the baseline, intervention, and maintenance phases for each participant. Generalization probes were implemented in the same activity center with the same materials that were used during the baseline, intervention, and maintenance sessions. However, a different adult (e.g., the classroom teacher) conducted the generalization probes in order to assess whether the learned skills generalized across people. Conducting generalization probes during all of the conditions provided stronger data regarding the effects of the intervention beyond the intervention phase (Kazdin, 1982).

Reliability

Interobserver agreement was assessed by having an independent observer collect data at the same time as the interventionist during at least 30% of all experimental conditions for each child (see Appendix E). The observer was a doctoral student in special education. The percent of interobserver agreement (e.g., correct, incorrect, no response) was obtained by dividing the number of agreements by the number of agreements plus disagreements, multiplied by 100. Mean interobserver agreement was 100% during baseline, 99% (range 80-100%) during intervention, and 100% during maintenance.

The same independent observer also observed the interventionist in order to assess procedural fidelity during at least 30% of all experimental conditions. The observer independently recorded whether each step of the intervention was implemented as specified in the procedures (see Appendix F). The formula to compute procedural fidelity was the number of procedural steps with correct implementation divided by the total number of procedural steps, multiplied by 100. Reliability data indicated the interventionist correctly performed the planned behaviors on 100% of arranged opportunities.

CHAPTER 3

RESULTS

Child Outcomes

Learned Numeracy/Math Skills

Figures 1, 2 and 3 show number of correct responses for the identified numeracy/math skill for Elizabeth, Steven, and Jill. Results are organized to illustrate the number correct during baseline, intervention, and maintenance conditions for each participant. Baseline data for all participants showed low and stable rates of correct responding. Elizabeth maintained a mean accuracy of 5% for number 2 (range=0-20%), 0% correct for number 3, and 5% for number 4 (range= 0-20%). Steven maintained a mean accuracy of 5% for number 6 (range=0-20%), 0% correct for number 7, and 0% correct for number 9. Jill maintained a mean accuracy of 5% for diamond (range=0-20%), 8% for rectangle (range=0-20%), and 0% correct for triangle.

Visual inspection of the intervention data reveals an increase in the level and slope of all participants' correct responses across all numeracy/math skills. Elizabeth maintained a mean accuracy of 79% for number 2 (range=40-100%), 63% for number 3 (range=0-100%), and 77% for number 4 (range=20-100%). Steven maintained a mean accuracy of 67% for number 6 (range=20-100%), 90% for number 7 (range=40-100%), and 77% for number 9 (range=20-100%). Jill maintained a 78% for diamond (range=0-100%), 90% for rectangle

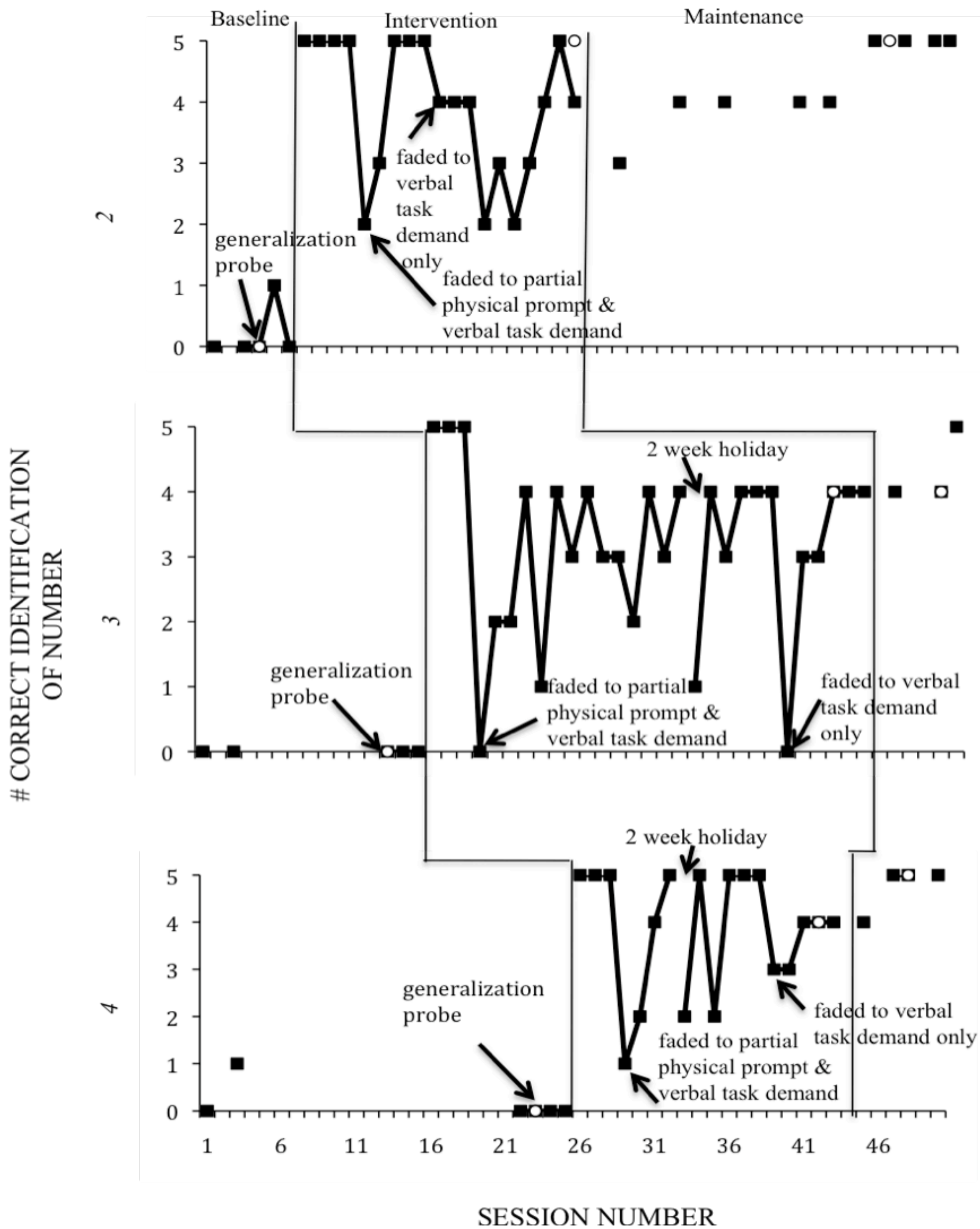

Figure 1. Number of correct identification of the numbers 2, 3, and 4 for Elizabeth

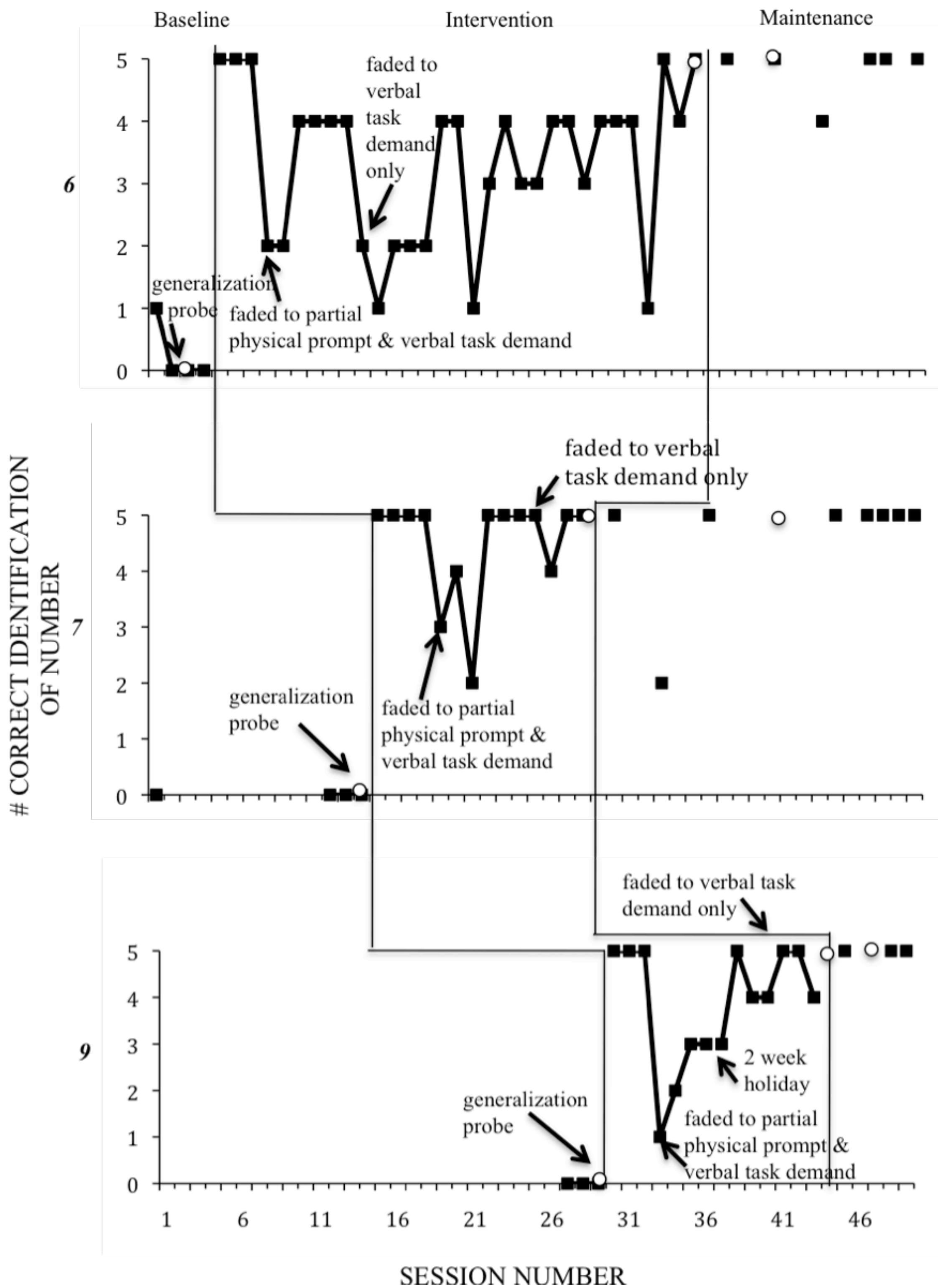

Figure 2. Number of correct identification of the numbers 6, 7, and 9 for Steven

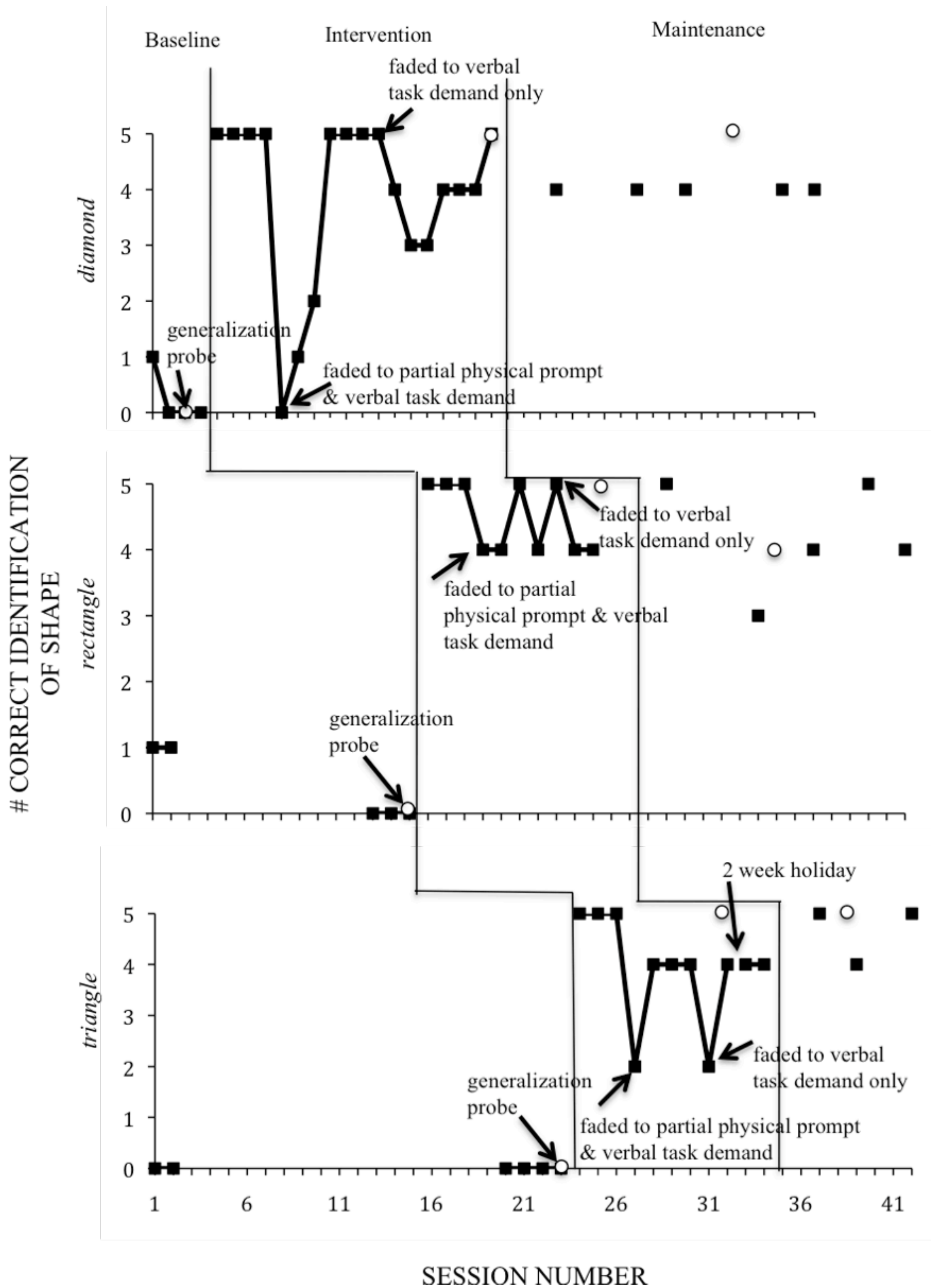

Figure 3. Number of correct identification of triangle, rectangle, and diamond for Jill

(range=80-100%), and 78% for triangle (range=40-100%).

During maintenance, Elizabeth maintained a mean accuracy of 87% for number 2 (range=60-100%), 87% for number 3 (range=80-100%), and 95% for number 4 (range=80-100%). Steven maintained a mean accuracy of 97% for number 6 (range=80-100%), 93% for number 7 (range=40-100%), and 100% for number 9. Jill maintained a mean accuracy of 80% for diamond, 72% for rectangle (range=60-100%), and 93% for triangle (range=80-100%).

Generalization probes for numeracy/math skills are also displayed in Figures 1, 2, and 3. During baseline, generalization probes for Elizabeth, Steven, and Jill were at 0% accuracy. Generalization probes across participants during intervention ranged from 80-100% accuracy. During the maintenance phase, participants' generalized use of target skills ranged from 80-100% accuracy.

Prestudy Questionnaire

Eight preschool teachers completed the prestudy social validity questionnaire where they rated their values/beliefs related to teaching numeracy/math in early childhood classrooms. The results of the prestudy social validity questionnaire are summarized in Table 5. As noted by Table 5, all of the teachers believed that preschool children are ready to learn mathematics, and that numeracy/math skills can be taught to all preschoolers, not only the smartest children. Of the eight teachers who completed this questionnaire, seven (88%) strongly agreed/agreed with statements indicating that (a) creating an enriched physical environment and simply letting children play is not enough, (b) introducing simple shapes and numbers is not enough mathematics for preschoolers, and (c) math could be taught as a subject in preschool. Six teachers (75%) strongly agreed/agreed with statements indicating

Table 5. Preschool teacher values and beliefs based on responses to the prestudy social validity questionnaire

Value or Belief	Strongly Disagree/ Disagree	Neutral	Strongly Agree/ Agree
Preschool aged children are not ready to learn mathematics.	8		
Mathematics is only for the smartest children.	8		
In preschool, introducing simple shapes and numbers is enough.	7	1	
Language and literacy are more important than mathematics during the preschool years.	6	1	1
Preschool teachers only need to provide an enriched physical environment and simply let children play.	7	1	
Assessment in mathematics is inappropriate for preschool children.	6	2	
Mathematics should not be taught as a subject during the preschool years.	7		1
Preschool aged children can only learn mathematics through using concrete objects.	4	2	2
Preschool children are not abstract thinkers.	4	4	
Computers are inappropriate for teaching mathematics to children in preschool.	3	4	1

that (a) literacy is not more important than mathematics, and (b) mathematics assessment is appropriate for preschoolers. Four teachers (50%) strongly agreed/agree with statements indicating that (a) preschool children cannot only learn math from concrete objects, and (b) preschool children are abstract thinkers. Finally, three (38%) of the teachers believed computers are appropriate for teaching mathematics in preschool.

Social Validity Survey

Both teachers in each of the three participants' classrooms were asked to anonymously complete this survey during the final week of maintenance. Four of the six preschool teachers completed the social validity survey during the last week of the study where they rated the extent to which they found each part of the intervention (e.g., integrating intervention into classroom activities, providing specific guidance, techniques used during the intervention) to be valuable, appropriate, and easy to implement. In addition, teacher perceptions regarding the impact of the strategy on the classroom environment were surveyed. The outcomes of the social validity survey are displayed in Table 6. Overall, the teachers believed that this intervention was valuable, appropriate, easy to implement, and they would use the strategy in the future if provided training. Of the teachers who completed the survey, 100% strongly agreed/agreed with statements regarding the ease of integrating the intervention into planned activities, not being disruptive of classroom activities, sessions being fun for the participant, and the ability for typical peers to participate in the activity when using the strategy with the child with a disability. In addition, 100% of the teachers strongly agreed/agreed that this strategy could be used in other learning centers to teach numeracy/math skills to children with disabilities, as well as to teach children with various types of disabilities. Finally, all of the teachers strongly agreed/agreed with statements

Table 6. Preschool teacher responses to the social validity survey

Statement	Strongly Disagree/ Disagree	Neutral	Strongly Agree/Agree
I can see the value in embedding this intervention strategy into scheduled classroom activities.			4
This intervention was easily integrated into the planned activities in the identified learning center.			4
The implementation of this intervention strategy did not disrupt classroom routines.			4
It was not difficult to provide specific guidance to help the child achieve the target skill.			4
The content of the intervention was appropriate for the student.			4
The sessions appeared to be fun for the student.			4
The numeracy/math goal for the child was relevant to future learning and skill development.			4
The needs of the other children in the classroom could still be met while implementing this strategy.			4
The intervention helped give me a more positive perception of integrating numeracy/math concepts into a preschool curriculum.			4
This intervention increased my own knowledge of using instructional strategies to teach numeracy/math skills to preschool children with disabilities.			4
The following techniques used during this intervention were acceptable: (a.) Full physical prompt (b.) Partial physical prompt (c.) Verbal prompt (d.) Consequences	(a.) 2	(d.) 2	(a.) 2 (b.) 4 (c.) 4 (d.) 2
This strategy can be used in other learning centers to teach numeracy/math skills to children with disabilities.			4
This strategy can be used to teach numeracy/math skills to children with various types of disabilities.			4
Typically developing peers can participate in the activity when using this strategy with a child with a disability.			4
The time that was required to implement this study was worth the observed benefits.			4
I would feel confident implementing this strategy if given training and support.			4
I think that other staff in the classroom, if given training and support, could implement this strategy.		1	3
I was satisfied with the outcome of the child's learning following implementation of this intervention.			4
I will use this strategy in the future.			4

indicating that the time required to implement this study was worth the observed benefits, and that they were satisfied with the outcome of the child's learning. Although all of the teachers strongly agreed/agreed with statements indicating that the partial physical and verbal task request strategies were very appropriate, two teachers (50%) strongly agreed/ agreed with the statement that the full physical prompt was appropriate. Also, two teachers (50%) strongly agreed/agreed with the statement that the consequences were acceptable, while the remaining teachers took a neutral position. Finally, three teachers (75%) strongly agreed/agreed that other classroom staff could implement this strategy with training and support, while one teacher had a neutral opinion regarding this statement.

CHAPTER 4

DISCUSSION

The questions addressed by this study were: (a) Is an intervention strategy comprised of creating opportunities, prompting, providing consequences, and prompt fading effective in teaching preschool children with disabilities numeracy/math skills in the context of identified classroom activities? and (b) How do preschool staff rate the acceptability and perceived effectiveness of the use of the strategy? Results of this investigation revealed that the intervention strategy was successful in teaching numeracy/math skills to preschool age children with special needs in an inclusive early childhood setting. These findings add to the empirical base on effective instructional strategies to teach various skills to individuals with special needs (e.g., Ault et al., 1988; Kearney, 2008; Navarro et al., 2004; Soluaga et al., 2008). In addition, the results of this study contribute to the knowledge base related to teaching numeracy/math skills during the early childhood years (National Association for the Education of Young Children, 2005; The National Council of Teachers of Mathematics NCTM, 2005). Finally, the outcomes of this study support literature indicating that (a) a most-to-least prompting strategy is an effective method for teaching individuals with disabilities to learn and generalize skills (e.g., Batu, Ergenekon, Erbas, & Akmanoglu, 2004, Vuran, 2008), and (b) young children with disabilities can learn new skills through embedded instruction in inclusive settings (e.g., Grisham-Brown, Schuster, Hemmeter, & Collins, 2000).

Although all three children successfully learned all of the numeracy/math skills with the most-to-least prompting strategy, there were some interesting findings related to intensity of intervention (e.g., number of opportunities/sessions per day). As mentioned previously, during the intervention phase, the number of sessions per day across participants ranged from one to two (resulting in either 5 or 10 opportunities per day). Post-hoc examination of the data revealed that Elizabeth participated in 37 intervention sessions across 30 days, Steven participated in 38 intervention sessions across 32 days, and Jill participated in 29 intervention sessions across 29 days. These results suggest that increases in the number of sessions per day did not decrease the number of days that it took to complete the intervention phase of the study. Specifically, Jill (who received only one session per day) learned all three numeracy/math skills in fewer days than Steven and Elizabeth, who each participated in two sessions per day on approximately 20% of the days. However, as an alternative explanation, Jill may have completed the intervention phase faster than Elizabeth and Steven due to differences in the skills that were taught. It is possible that learning to identify shapes (Jill's goal) may be more quickly acquired than learning to identify number symbols (Elizabeth's and Steven's goals). Examining outcomes in relation to intensity of intervention as well as in relation to differences between skills being taught is important as interventionists strive to develop and implement strategies that are efficient as well as effective (Reynolds, Temple, Ou, Arteaga, & White, 2011; Zhai, Raver, Jones, Li-Grining, Pressler, & Gao, 2010).

Another interesting outcome of this study related to differences regarding which skill (the first, second, or third) had the most intervention sessions with fewer than three correct responses per session. For two of the three participants, the most intervention sessions with less than three correct responses occurred when teaching the first skill (Steven participated in nine sessions and Jill participated in three sessions with less than three correct responses). One plausible explanation for this finding may be that this was the first time that these participants had experienced numeracy/math instruction and/or embedded instruction. As the participants became more familiar with these instructional strategies, it may have become easier for them to learn the targeted numeracy/math skills. Conversely, the third participant (Elizabeth) had the most intervention sessions with fewer than three correct responses when teaching the second skill. It is plausible that, during the intervention phase for the first skill, Elizabeth simply learned to match a single verbalized number to the corresponding written symbol. However, when the second skill was being taught, Elizabeth had to (a) learn to match the second verbalized number to the corresponding written symbol, and (b) respond conditionally depending on which number was being requested (Cooper, Heron, & Heward, 2007). The design of this study does not allow for strong conclusions with regard to why there was variability in terms of which skills had the most intervention sessions with less than three correct responses. However, the presence of different trends across participants suggests that interventionists should be prepared for variability in rate of acquisition across target skills, even when the target skills are related.

Finally, there were some interesting findings related to trends in error responses during the intervention phase for all of the participants. For example, when Steven was learning the first target skill (to identify the number symbol 6), 89% of his errors were emitted by choosing the number symbol 9. Furthermore, when Steven was learning the third target skill (to identify the number symbol 9), 50% of his errors were emitted by choosing the number symbol 6. This finding supports literature suggesting that number/letter symbols that are similar in appearance are more difficult to discriminate. A second notable trend in error responses was related to the frequency with which participants chose the most recently taught skill when emitting an error (e.g, choosing the first target skill when being taught the second skill, choosing the second target skill when being taught the third skill). This trend was particularly notable for Jill and Elizabeth. Specifically, upon examination of error responses when teaching the second target, Jill and Elizabeth chose the first target 100% and 58% of the time, respectively. Furthermore, upon examination of error responses when teaching the third target, Jill and Elizabeth chose the second target 100% and 79% of the time, respectively. Based on this error analysis, future research examining the extent to which changes in the instructional sequence/targets influence the efficiency and/or effectiveness of learning is warranted.

Preschool Teacher Values and Beliefs

Data from the prestudy questionnaire suggest that the preschool teachers who participated in this study are beginning to change their views regarding numeracy and/or mathematics being taught in early childhood classrooms and misconceptions that have been identified in previous research may be declining (Lee & Ginsburg, 2009). Specifically, in contrast to the findings of Lee and Ginsburg (2009), the majority of teachers involved in this study believed that (a) children are ready to learn mathematics skills during the early childhood years, (b) mathematics is not only for the smartest children, (c) it is not enough to simply introduce simple shapes and numbers, (d) teachers need to do more than provide an enriched environment and simply let children play, (e) literacy is not more important than mathematics during the preschool years, (f) assessment in mathematics is appropriate for preschool children, and (g) mathematics can be taught as a subject during the preschool years.

However, results from this study were similar to the findings of Lee and Ginsburg (2009) with regard to abstract thinking, use of concrete objects, and use of computers to teach mathematics. Specifically, 50% of the preschool teachers responded with “neutral” to the statement that preschool children are abstract thinkers. This suggests that some early childhood teachers are unsure about whether abstract concepts are appropriate for preschool age children despite literature to the contrary (Church, 2012; Piaget & Inhelder, 1969; Poole, Miller, & Church, 2005; Scholastic, 2012). Next, 50% of the preschool teachers “agreed/strongly agreed” with the statement that preschool children can only learn math through the use of concrete objects. However, Clements and Sarama (2012) discuss that young children (3 ½ years) are able to compare dissimilar groups that they can and cannot see (e.g., rocks and a series of claps). Further, by about age 4-4 ½ years, children can compare groups that are made up of a mixture of objects and realize that anything can be counted and it does not have to be concrete (e.g., jumps, dog barks, or missing eggs from an egg carton). This demonstrates that children do have the ability to recognize numeration as an abstract idea, and it is not dependent upon the use of concrete objects (Poole et al., 2005; Scholastic, 2012). Finally, 63% of preschool teachers in this study were either “neutral” or “agreed/strongly agreed” with the statement that computers are inappropriate for teaching math to children in preschool. As was the case with regard to abstract thinking and the use of concrete objects, this belief is not supported by the literature. Specifically, research has shown that computers can be used effectively to teach math/numeracy skills to young children, including those with special needs (Clements, 1999; Lee & Ginsburg, 2009).

Social Validity

Findings from the social validity survey support the use of the most-to-least prompting strategy to teach numeracy/math skills to preschool aged children with disabilities. The preschool teachers who participated in the social validity survey unanimously "strongly agreed/agreed" that the instructional strategy used in this study was very important, appropriate, and not difficult to implement. Furthermore, all of the teachers who participated in this survey believed that they could implement the intervention used in this study with proper instruction and training. The majority (75%) of the teachers also thought that other staff in the classroom, if given training and support, could implement this strategy as well. This finding is consistent with prior research suggesting that teachers are more confident and more likely to put new strategies into practice if they receive appropriate instruction, training, and support (Kosanovich, Reed, & Miller, 2010).

It is interesting to note that responses varied when asked about two of the techniques (physical prompts and consequences) used during the intervention. Half of the teachers agreed with the use of full physical prompts while the other half of the teachers disagreed with this prompting technique. One plausible explanation for this finding might be that some teachers are more used to using least-to-most prompt hierarchies and that the use of a full physical prompt at the start of the intervention was seen as too intrusive. If this was the case, teachers might benefit from more information on most-to-least prompt hierarchies including information on when most-to-least prompt hierarchies might be effective (e.g., Bailey & Wolery, 1992). The teachers also showed differing opinions concerning the use of consequences. Specifically, half of the teachers agreed with the use of consequences while the other half of the teachers were neutral. A possible explanation to this response may be that, even though the teachers observed some of the sessions, some may not have taken note of the actual consequences because they were natural. If this was the case, teachers may benefit from additional information related to natural consequences, including the value of providing participants with corrective feedback (Fazio, Huelser, Johnson, & Marsh, 2010; Pashler, Cepeda, Wixted, & Rohrer, 2005; Roper, 1977). Another possible explanation for the teachers' differing responses may have been due to the terminology using in the survey (e.g., full physical prompts, consequences). The teachers may have had different responses if descriptive information (e.g., helping the child point to the symbol by providing hand-under-hand guidance) were used.

Limitations

Each of the children who participated in the study stayed in an identified learning center throughout all phases of the study, including generalization. Although participants generalized their use of target skills to new people (e.g., classroom teacher), this study does not provide data regarding whether the skills generalized to other learning centers within the classroom or to other settings (e.g., home). Also, the outcomes of this study may be different if the children were asked to generalize the learned numeracy/math skill to other materials that incorporated different fonts for number symbols, shapes of objects in the environment, or three-dimensional shapes. Finally, participants in this study were taught to identify the target number/shape from an array of five numbers/shapes. A five-item array was chosen because the Brigance Developmental Inventory presents shape and number concepts in sets of five. However, the outcomes of the investigation may be different if the overall size of the array was increased.

In addition, the skills taught in the context of this study relate only to shape and number identification. These are only a small component of two mathematical learning groups (number and operations, and geometry) which are part of a much larger compilation of other learning areas relating to mathematics that have been identified by NAEYC and NCTM (National Association for the Education of Young Children, 2005; The National Council for Teachers of Mathematics, 2005). The outcomes of this study may be different when teaching (a) other skills within the areas of number operations and geometry, and/or (b) skills in other mathematical learning sets (e.g., measurement, algebra, or data analysis).

Implications for Future Research and Practice

This investigation opens the door for future research activities. First, future research should examine the effectiveness of the same intervention strategy when implemented by the classroom teacher rather than the researcher. Second, future research should explore the efficiency and effectiveness of using this intervention strategy to teach additional numeracy/math skills since number and shape identification are only two of several important numeracy/math skills. Future investigations should also examine strategies for teaching other math concepts such as measurement, patterns, data analysis, or problem solving (The National Council of Teacher of Mathematics NCTM, 2005 and The National Association for Education of Young Children, 2005). Finally, future research should continue to examine preschool teacher's values and beliefs regarding mathematics in preschool because research related to teaching numeracy/math is not likely to be translated into practice if the areas being researched do not align with teachers' values/beliefs.

In addition to future research, the outcomes of this study also provide implications for practice. Specifically, results suggest that (a) the intervention strategy of most-to-least prompting was an effective way to teach numeracy/math skills to young children with special needs in inclusive environments, (b) preschool teachers were accepting of the intervention strategy, and (c) preschool teachers' misconceptions are changing and they are becoming more accepting of teaching numeracy/math skills at the preschool level. Given this, the timing may be right to (a) provide early childhood teachers with knowledge regarding effective strategies for embedding learning opportunities and teaching numeracy/mathematics skills in inclusive early childhood classrooms through in-services and continuing education, and (b) support early childhood teachers as they utilize this knowledge.

APPENDIX A

DATA COLLECTION FORM

Child's Name: ________________________________ Date: __________________

Activity Center/Materials____

Goal: ____

Target Objectives: ____________________________ Time Started: ____________ Time Ended: ____________

Opportunity	Phase/ Objective	Prompt Used	Correct Response	Incorrect Response	No Response	Notes
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						

APPENDIX B

QUESTIONAIRE FOR PRESCHOOL STAFF

Based on your own beliefs, please rate each of the following statements according to the following labels: 1 Strongly Disagree, **2** Disagree, **3** Neutral, **4** Agree, **5** Strongly Agree

	1	2	3	4	5
Q1. Preschool aged children are not ready to learn about mathematics in preschool.	○	○	○	○	○
Q2. Mathematics is only for the smartest children in preschool.	○	○	○	○	○
Q3. In preschool, introducing simple shapes and numbers is enough.	○	○	○	○	○
Q4. Language and literacy are more important than mathematics during the preschool years.	○	○	○	○	○
Q5. Preschool teachers only need to provide an enriched physical environment and simply let children play.	○	○	○	○	○
Q6. Assessment in mathematics is inappropriate for preschool children.	○	○	○	○	○
Q7. Mathematics should not be taught as a subject during the preschool years.	○	○	○	○	○
Q8. Preschool aged children can only learn mathematics through using concrete objects.	○	○	○	○	○
Q9. Preschool children are not abstract thinkers.	○	○	○	○	○
Q10. Computers are inappropriate for teaching mathematics to children in preschool.	○	○	○	○	○

APPENDIX C

SURVEY FOR PRESCHOOL STAFF

Based upon your observations, please rate each of the following statements according to the following labels: 1 Strongly Disagree, **2** Disagree, **3** Neutral, **4** Agree, **5** Strongly Agree

	1	2	3	4	5
Q1. I can see the value in embedding this intervention strategy into scheduled classroom activities.	○	○	○	○	○
Q2. This intervention was easily integrated into the planned activities in the identified learning center.	○	○	○	○	○
Q3. The implementation of this intervention strategy did not disrupt classroom routines.	○	○	○	○	○
Q4. It was not difficult to provide specific guidance to help the child achieve the target skill.	○	○	○	○	○
Q5. The content of the intervention was appropriate for the student.	○	○	○	○	○
Q6. The sessions appeared to be fun for the student.	○	○	○	○	○
Q7. The math/numeracy goal for the child was relevant to future learning and skill development.	○	○	○	○	○
Q8. The needs of the other children in the classroom could still be met while implementing this strategy.	○	○	○	○	○
Q9. The intervention helped give me a more positive perception of integrating math/numeracy concepts into a preschool curriculum.	○	○	○	○	○
Q10. This intervention increased my own knowledge of using instructional strategies to teach math/numeracy skills to preschool children with disabilities.	○	○	○	○	○
Q11. The following techniques used during this intervention were acceptable:					
(a.) Full physical prompt	○	○	○	○	○
(b.) Partial physical prompt	○	○	○	○	○
(c.) Gestural prompt	○	○	○	○	○
(d.) Consequences	○	○	○	○	○

	1	2	3	4	5
Q12. This strategy can be used in other learning centers to teach math/numeracy skills to preschool children with disabilities.	○	○	○	○	○
Q13. This strategy can be used to teach math/numeracy skills to children with various types of disabilities.	○	○	○	○	○
Q14. Typically developing peers can participate in the activity when using this strategy with a child with a disability.	○	○	○	○	○
Q15. The time that was required to implement this study was worth the observed benefits.	○	○	○	○	○
Q16. I would feel confident implementing this strategy if given training and support.	○	○	○	○	○
Q17. I think that other staff in the classroom, if given training and support, could implement this strategy.	○	○	○	○	○
Q18. I was satisfied with the outcome of the child's learning following implementation of this intervention.	○	○	○	○	○
Q19. I will use this strategy in the future.	○	○	○	○	○

Comments:

APPENDIX D

NUMERACY/MATH SKILLS ASSESSED BASED ON THE HIGH SCOPE AND BRIGANCE DEVELOPMENTAL TOOLS

Participant Name: ________________________________ Date: ____________

BASIC MATH SKILL	NOTES
Number Concepts: Demonstrates number concepts from 1-10	
Rote Counting: Counts by rote to:	
Reads Numerals: Recognizes numerals to:	
Numeral Comprehension: Matches quantity with the number symbol:	
Ordinal Position: Demonstrates comprehension of first, last, second, middle, third, forth, etc.	
Quantitative Concepts: many/one, little/big, empty/full, short/tall, less/more, thin/thick	

Shape Concepts: Matches, and/or points to when named (e.g., circle, square, triangle, rectangle, diamond).	
Classifying: animals, toys, foods, numbers, fruits, shapes	

APPENDIX E

INTEROBSERVER AGREEMENT COLLECTION FORM

Child's Name: ______________________ Date: ________

Activity Center/Materials:____

Goal: __________________________Target Objectives: __________________________

Time Started: ______ Time Ended: ______ Observer: ____________________________

Opportunity	Phase/ Objective	Prompt Used	Correct Response	Incorrect Response	No Response	Notes
1						
2						
3						
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14						
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APPENDIX F

PROCEDURAL RELIABILITY COLLECTION FORM

Date: ____________________________

Opportunity	Step
1	1. Create opportunity Yes No 2. Establish physical proximity with the student Yes No 3. Establish attention with the student Yes No 4. Simultaneously provide request and appropriate prompt Yes No 5. Provide appropriate consequence and feedback Yes No
2	1. Create opportunity Yes No 2. Establish physical proximity with the student Yes No 3. Establish attention with the student Yes No 4. Simultaneously provide request and appropriate prompt Yes No 5. Provide appropriate consequence and feedback Yes No
3	1. Create opportunity Yes No 2. Establish physical proximity with the student Yes No 3. Establish attention with the student Yes No 4. Simultaneously provide request and appropriate prompt Yes No 5. Provide appropriate consequence and feedback Yes No
4	1. Create opportunity Yes No 2. Establish physical proximity with the student Yes No 3. Establish attention with the student Yes No 4. Simultaneously provide request and appropriate prompt Yes No 5. Provide appropriate consequence and feedback Yes No
5	1. Create opportunity Yes No 2. Establish physical proximity with the student Yes No 3. Establish attention with the student Yes No 4. Simultaneously provide request and appropriate prompt Yes No 5. Provide appropriate consequence and feedback Yes No

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